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FOR WOOD, WITH DETAILS OF THE FUNDAMENTAL PRINCIPLES AND THE ALLIED
PROCESSES. ALSO OIL VARNISHING
AND CELLULOSE SPRAYING, WITH
SOME DETAILS OF EQUIPMENT

BY

H. T. DAVEY
MEMBER OF THE ADVISORY COMMITTEE
ON RAILWAY CARRIAGE AND WAGON BUILDING
CITY AND GUILDS OF LONDON INSTITUTE

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# PREFACE

THIS book has been written to assist the student in acquiring the fundamental principles of an old-established craft which, although having undergone the revision necessary to meet modern requirements and conditions, is still a branch of industry which calls for recruits with the highest talent and artistic skill. While the spray gun has in many directions replaced the familiar french polisher's rubber, there is still a great demand for the highly skilled finisher for the best class of work, and even in the modern cellulose shop the rubber is still much in use.

It has been considered desirable to include a chapter giving details of the characteristics and some physical features of timber, chiefly of the harder varieties, since the training of a finisher cannot surely be considered complete without such knowledge.

Many of the processes described and the methods advocated have been tried out by the writer and are considered to be satisfactory. In such a subject as this, however, there is always plenty of scope for ingenuity and skill in the production of new methods and effects.

To the amateur and handyman, some appeal should be made by the book. All too often good woodwork is seen to have been spoiled by inferior finishing, while domestic jobs, too, suffer very much from amateurish efforts. The lack of knowledge of the fundamental principles is largely responsible for these failures and poor work generally, while such results can also be attributed to the use of cheap and also to unsuitable materials. Much patience, too, as well as skill, is required in this work.

The writer is indebted to the following firms who have kindly supplied data relating to the many and varied products marketed, and in particular to the Cellon Co. Ltd., Kingston-on-Thames, for demonstrations of their cellulose plant and methods of production: Aeraspray Manufacturing Co. Ltd., Birmingham; Aerograph Co. Ltd., London; the Bromak Pneumatic Brush Co. Ltd., London; Gedge & Co., London; Hamilton & Co., London; J. Manger & Son Ltd., London and Stafford; Parsons, Mitcham; Pinchin Johnson Ltd., London; Ronuk Ltd., Portslade; Stephenson Clarke & Associated Co. Ltd., London.

I am also indebted to my colleague Mr. W. A. Cobb for his suggestions and kindly criticisms, to my wife for helping with the compilation of the text, to my colleague Miss R. M. Hallett for kindly typing the manuscript, and to Miss B. J. Wheatley for assisting in checking the proofs. Also to my colleague Dr. E. S. Gyngell for his help with the chemistry data.

H. T. D.

LONDON, 1940

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# WOOD FINISHING

## CHAPTER I

### INTRODUCTORY

BEFORE discussing in detail the various finishes applied to cabinet and decorative woodwork, some general remarks relating to timber seem appropriate.

The scope of this book does not, however, permit a very detailed study of the many varieties of timber used in the various wood trades. Nevertheless it is at least interesting, and to some extent essential, that one whose business is so closely connected with woods should have a knowledge of their particular usefulness and superficial characteristics.

For the benefit of the reader with a little deeper interest in the subject, and to enable accurate discrimination and classification to be made, the botanical names of the various timbers have been given. Some of the names by which certain varieties of wood are commonly known tend to be misleading.

It is also important to know something of the characteristics of the varieties of the same timber bearing the same popular names. Different varieties of the same species are often produced in widely different localities, and may therefore possess very different characteristics, making one or the other more suitable for a particular purpose. For example, Japanese Oak and English Oak have a marked difference in colour, working, specific gravity, and durability, as well as in price. A difference in grain is also often a striking feature in these two examples. The former, as its name implies, comes from the East, and grows in a soil and in surroundings quite different from the latter, and is a much faster-growing tree. These conditions produce the differences mentioned. Similar comparisons may be made with the varieties of Mahogany and other species of timber.

These facts are mentioned here as the finishing process, whatever it may be, might be influenced to some extent by the particular variety of the wood used. The texture or condition of the grain is all-important in this latter respect.

In the timber trade it is common to make two classifications in regard to wood, one group being referred to as hardwood and the other as softwood. Comparatively speaking, there is more hardwood used in cabinet work than softwood, although certain varieties of the latter are common in the cheaper branches of the trade. Thus it will be in order to devote most attention to the former and to include those kinds of the latter which may act as cheap substitutes or are useful for less-important work for which the probable extra cost of hardwood might not be warranted.

In the hardwood group many beautiful varieties are to be found. Some, too costly and too heavy for general use in furniture making, are admirably suited for cutting into veneers, and are useful for decorative work and panelling.

For example, although at the present time there is less demand for Mahogany than hitherto, yet magnificently figured specimens of this beautiful wood can be obtained, and in the hands of a skilled polisher can be rendered permanent examples of exquisite beauty. The most decorative specimens of these timbers are burred and are cut into veneers, since it is comparatively scarce, and consequently very expensive. Small sheets of burred Mahogany veneer, about 15 in. × 8 in., known in the trade as Cuban curls, often have most exquisite figuring and make up into very fine panels.

One well-known firm of timber importers has paid in the open market as much as 26s. per foot super (as 1 in. thick) for timber of this description to cut into veneers.

At the present time burr Walnut is in great demand for furniture making, including wireless and gramophone cabinets, while years ago it was commonly used for pianoforte cases. Here again well-marked specimens of this timber are obtained, cut into veneers, and glued down to good backings. Highly figured wood of this kind is hardly ever used in bulk form. It is far too expensive, and after all it is only outside surface effect that is needed, and hence a veneer if put on well gives the desired effect.

## DESCRIPTIVE LIST OF WOODS

For the purpose of comparing the weights of the following varieties of wood, 1 cu. ft. of fresh water weighs 62·4 lb.

ACACIA (*Robinia pseudacacia*). A hardwood and a native of Europe, possessing a rich dark yellow colour. It is durable, and generally stronger and tougher than Oak. Not commonly used in cabinet work, but is admirably suited to decorative work. Takes an excellent polish. Weight, 51 lb. per cubic foot.

ALDER (*Alnus glutinosa*). Grows extensively in Great Britain, is brown in colour and particularly durable in damp and wet surroundings. It is easy to work, and is used for light turnery and similar purposes. Now in considerable demand for the manufacture of plywood. Weight, 30 lb. per cubic foot.

ALMOND WOOD (*Chukrasia tabularis*). Grown in India, of a brownish colour and possessing a fine silvery grain and satin lustre. Used for carvings and certain classes of furniture. Works up well. Weight, 49 lb. per cubic foot.

ASH, AMERICAN, CANADIAN, AND ENGLISH (*Fraxinus*). This is grown extensively in the British Isles and North American continent. White to cream in colour, generally with a brownish open grain. Easy to work. Was in demand years ago for furniture, but not much so nowadays. Requires plenty of air, otherwise durability impaired. Weight, 41–6 lb. per cubic foot.

Ash, Japanese (*mandochurica*). A Japanese tree producing timber hardly as strong as the English variety, but used for carriage work, interior decoration, and cabinet work, since it gives an excellent finish. Weight, 35 lb. per cubic foot.

Basswood (*Tilia americana*). This wood is too often confused with Canary Whitewood (*liriodendron tulipifera*), both natives of North America. Basswood is white to cream in colour, rather soft, and very easy to work. Used considerably in the pianoforte trade, also for furniture manufacture and general purposes. Weight, 30 lb. per cubic foot.

Beech (*Fagus sylvatica*). A European timber of light fawn or buff colour. The medullary rays exhibit a brilliant lustre in the form of small freckles when timber is cut on the quarter. This wood is hard and often rather difficult to work. Its grain is, however, generally very even and consistent. Used for chairs and chair frames, tool handles, turnery, and many other purposes. Weight, 42 lb. per cubic foot.

Birch (*Betula*). This is a European and North American tree producing a tough durable timber which works up to an excellent finish. A great deal of this wood is now used for the manufacture of plywood, and to some extent for furniture making. Weight, 48 lb. per cubic foot.

Blackwood, African (*Dalbergia melanoxylon*). Known in some quarters as Senegal Ebony. Grows in the tropical forests of Africa, and is often jet-black in colour, although much of it is no more than dark brown. Possesses a pleasing fragrance. Used for musical instruments and turnery. Weight, 74 lb. per cubic foot.

Blackwood, Australian (*Acacia melanoxylon*). Grows in Australia and is often magnificently figured, hence good specimens are cut into veneers for panelling. Generally of dark reddish-brown colour, possessing a brilliant sheen. Easy to work and used for cabinet work and many other purposes. Weight, 45 lb. per cubic foot.

BLACKWOOD (*Brehemeria rugulosa*). An Indian variety, dark red in colour and rather hard. Finishes well and is excellent for carving, and also well suited for turnery. Weight, 41 lb. per cubic foot.

BOXWOOD (*Buxus sempervirens*). This variety of Boxwood grows abundantly in Asia Minor and parts of Europe. It is a very hard, close-grained wood, and takes an exceptionally fine polish. Used in turnery, for sports equipment, and for many other purposes. The weight may be taken as approximately 60 lb. per cubic foot. Other varieties of Box are Knysna (*Gonioma Kamassi*), an African specimen, weight 58 lb. per cubic foot and *Calophytium spectabile*, weight about 30 lb. per cubic foot. Is grown in India and Ceylon, and is of a light red colour very close-grained. Used for masts, spars, and planking.

CAMPHORWOOD (*Cinnamomum camphora*). Grown in Japan, of light brown colour and fairly close-grained. On account of its fragrance is used mainly for linings to drawers and for cabinets. Weight, 40 lb. per cubic foot. A harder variety (*Dryobalanops aromatica*) grows in Borneo, but is not generally used for cabinet work. Weight, 47 lb. per cubic foot.

CEDAR. This is a name applied to many varieties of *Juniperus* and *Cedrela*, the only true varieties being Himalayan (*Deodar*), Atlantic, and Cedar of Lebanon.

CEDAR, CIGAR-BOX (*Cedrela odorata*). This grows in Central America, and is known also as West Indian Cedar. A fragrant wood of rather soft nature and of reddish-brown colour. Weight, 30 lb. per cubic foot.

CEDAR MOULMEIN (*Cedrela Toona*). An Indian variety of rich red colour which works well and easily; durable. Valued for cabinet work, furniture, and carving. Weight, 30 lb. per cubic foot.

Cedar, Pencil (*Juniperus virginiana*). Grown in the U.S.A., and is known also as Virginian and Red Cedar. It is light, distinctly soft, fine-grained, and durable. Used extensively for pencils, but only in a small way for cabinets and panelling. Weight, 30 lb. per cubic foot.

Chaplash (*Artocarpus chaplasha*). Yellowish brown colour of consistent grain; durable. Grown in India and used occasionally for furniture. Weight, 34 lb. per cubic foot.

Chestnut (*Castanea vesca*). A European tree known popularly as Sweet or Spanish Chestnut. The wood is similar to Oak, and is light to dark brown in colour. The absence of the medullary ray so pronounced in Oak makes it easily distinguishable from this wood which it otherwise so closely resembles. It is also rather tougher than Oak but hardly as strong, and is also easier to work. Used in cabinet work and panelling. Chestnut is not attacked by the wood-boring beetle and serves as a protection to Oak when mixed with it. Weight, 30–40 lb. per cubic foot.

Cocobolo (*Dalbergia retusia*). A South American timber of very fine dark red colour, often with black or yellowish brown streaks. It is hard and strong, and used mostly in the form of veneers for brush backs, handles, turnery, and decorative work. Weight, 70 lb. per cubic foot.

Cocobolo, Indian (*Dalbergia cultrata*). Similar to above in both appearance and weight. Used also for similar purposes as the South American variety.

Cocus Wood (*Brya ebenus*). A West Indian wood of dark brown colour with fine, even grain. Used for musical instruments. Weight, 70 lb. per cubic foot.

Coromandel, or Calamander Wood (*Diospyros quaesita*). Grown in Ceylon and of greyish brown colour, often with blackish streaks. In considerable demand for cabinet work and ornamental work generally. Weight, 57 lb. per cubic foot.

Ebony (*Diospyros*). Several kinds of this wood are found in

India, Ceylon (*ebenum*), and Africa (*dendo*). It is rarely jet black, some of the African even being white. Used often as veneer for cabinet work and also for brush backs, trinket boxes, and inlays. Used also for turnery and cabinet work generally. Weight, 60–80 lb. per cubic foot.

ELM, ENGLISH AND AMERICAN (*Ulmus campestris and americana*). Grows in Europe and the North American continent. Is of a darkish brown colour with very twisted grain, and hence rather difficult to work. Compared with Oak, it is neither so strong nor stiff. Used for chair frames. Weight, 40 lb. per cubic foot. Other varieties are Rock Elm (*Ulmus rocimosa*), now getting scarce. Weight, 45 lb. per cubic foot. Also Wych or Scotch Elm.

HALDU, INDIAN (*Adina cordifolia*). This is a most beautiful wood for cabinet making, having a lustrous golden yellow colour and even grain. Particularly useful for turnery and carving. Weight, 42 lb. per cubic foot.

HICKORY (*Carya alba*). Grows in North America and is white to buff colour. Very tough, strong, and elastic. Used for chair making. Weight, 50 lb. per cubic foot.

HORNBEAM (*Carpinus betulus*). A European timber of yellowish white colour, hard and close-grained. Used for pianoforte keys. Weight, 50 lb. per cubic foot.

IROKO (*Chlorophora excelsa*). Grows in tropical parts of Africa, and is often called (incorrectly) African Teak. Is of yellowish brown colour, but is inclined to darken when exposed. Strong and straight-grained. Often used as a substitute for Teak. Used in cabinet work. Weight, 38–45 lb. per cubic foot.

KAKI (*Diospyros kaki*). Growing in Japan, this wood is often called Japanese Ebony. It is a dark greyish colour with black streaks. Used for turnery and ornamental work. Weight, 63 lb. per cubic foot.

KEYAKI (*Zelkowa acuminata*). Also grows in Japan, and is hard and strong. Has a brilliant lustre, and well-figured specimens are often obtainable. Used in cabinet work and carving. Weight, 41 lb. per cubic foot.

KINGWOOD (*Dalbergia*). A native of Brazil and a very fine looking timber, of dark brown colour with shades of crimson, violet and purple streaks in a fine grain. Used in fancy cabinet work, generally in the form of veneer, and also in turnery. Weight, 63 lb. per cubic foot.

LABURNUM (*Laburnum vulgare*). A European hardwood of a dark brownish colour with close grain. Used in turnery, and takes an excellent polish. Weight, 52 lb. per cubic foot.

LANCEWOOD, INDIAN, GREY (*Vitex glabrata*). Grows in India and Ceylon. Of light greyish brown colour, with a ripple figure and lustrous appearance. Takes an excellent polish. Weight, 42 lb. per cubic foot. Other varieties are Burmese (*Homalium tomentosum*), weight, 59 lb. per cubic foot, and a Central American variety (*Guatteria virgata*), weight 50 lb. per cubic foot. The two latter are most suited to furniture making, although not extensively used.

LUMBAYAU (*Tarrieta javanica*). Grown in the Philippine Islands, and of light to darkish red colour. Fairly light and easy to work. Used in furniture making. Weight, 44 lb. per cubic foot.

MAGNOLIA (*Magnolia acuminata*). A wood largely grown in the U.S.A.; it resembles Canary Whitewood. It is light, soft, and easily worked. Used for interior fittings such as cheap mantel-boards, etc., and occasionally in cabinet work. Weight, 30 lb. per cubic foot.

MAHOGANY. Species not definitely known. Grown in several parts of the world. One of the most beautiful of all woods for cabinet work, but owing to the prohibitive price due to scarcity of the best qualities has lost a good deal of its popularity in recent years. The Spanish variety grows in San Domingo. Other varieties come from Cuba, Honduras, Panama, and Central American localities, and also West Africa. Most of it is easy to work and produces an excellent finish. The Spanish variety is particularly rich in colour.

In recent years a light-coloured wood, the grain of which closely resembles Mahogany in many respects, has been on the market, and is generally sold as Mahogany. In reality this is an African Bay wood. The only true Mahogany is probably *Swietenia*.

Weight of Mahogany varies from 29 lb. to about 53 lb. per cubic foot.

MAHWA (*Bassia latifolia*). An Indian and Burmese wood of reddish brown colour used in furniture making. Weight, 62 lb. per cubic foot.

MAPLE (*Acer*). Grows in Canada, the U.S.A., and elsewhere. Possesses a creamy white appearance and even grain. A very tough and strong wood, suited to hard wear. Often cut into veneers for interior panelling and decorative work. The figured variety known commonly as Birdseye Maple is often used for cabinet making and interior decoration of railway coaches. Weight, 40 lb. per cubic foot.

MARBLEWOOD (*Diospyros Kurzii*). This wood grows in the Andaman Islands, and is a very handsome wood of grey colour streaked black. Has a peculiar cold feeling when touched. Used for cabinet work and also for walking-sticks. Weight, 61 lb. per cubic foot. Other varieties include *Melia composita*, which grows in India, having a weight of 28 lb. per cubic foot, and also *Messua ferrea*, a Burmese wood having a weight of 71 lb. per cubic foot. The two latter are not used in cabinet or furniture making.

MYALL OR VIOLET WOOD (*Acacia pendula*). An Australian wood of very fine dark brown colour. It is very hard and close-grained, often well figured. Too heavy for furniture, but often cut into veneers, and used also for turnery. It has a weak violet scent, hence its name. Weight, 76 lb. per cubic foot.

OAK (*Quercus*). This wood is one of the best known and most widely used of all timbers. Very strong and durable, and a very fine timber. It grows in many parts of the world.

BRITISH VARIETY (*Quercus pendunculata*). This is hard, tough, and strong, and of light fawn colour. Used for large doors, etc., furniture, and cabinet work. Often nicely figured and takes an excellent finish. Weight, 53 lb. per cubic foot.

JAPANESE OAK (*Quercus grosseserrata*). Large supplies of this variety are now obtainable at prices considerably cheaper than those of English Oak. Rather darker in colour than the latter, but very uniform in colour and easier to work. It is difficult to distinguish it from some European varieties without very close scrutiny with a magnifying glass. Used extensively in best classes of cabinet work. Weight, 40 lb. per cubic foot. European varieties include Austrian, Danzig, French, Italian, and Riga.

American Oak embodies over twenty botanical species, and hence there is a great variation in the quality of supplies. American Oak is not used in the best class of work. Weight averages about 42 lb. per cubic foot. Oak is also in demand for plywood, in which two thin sheets are glued to a thicker sheet of softwood, which forms the centre lamination.

PADOUK (*Pterocarpus dalbergioide*). This is a very fine dark crimson wood, often streaked with black or brown, and finely figured. It grows in the Andaman Islands, works well, and takes an excellent polish. This wood is first class for the interior decorations of public buildings, and also for furniture. Largely used in America for the interior decoration of railway cars. Weight, 48 lb. per cubic foot.

Another variety (*macrocarpus*, from Burma) is similar to the above, but darker in colour and heavier. Used for similar purposes as the former, but regarded in some quarters as an inferior timber. Weight, 60 lb. per cubic foot.

PARTRIDGE WOOD (*Andira inermis*). This wood grows in

Brazil and is a reddish brown colour, sometimes almost black, with figures and mottling. Used for cabinet work, umbrella and walking-sticks, and turnery. Weight, 48 lb. per cubic foot.

PEARWOOD (*Pyrus communis*). This is a European wood of dull brown colour. It is tough and close-grained, and does not easily split. Hence it is useful for carving and wood engraving. Used also for musical instruments and turnery. Weight, 50 lb. per cubic foot.

POPLAR (*Populus*). A European timber of light reddish brown colour, and rather soft. Used for turnery, but in greater demand for plywood. Weight, 30 lb. per cubic foot.

PRIMA VERA, or WHITE MAHOGANY. Grows in North America, and is of light yellowish colour and often figured. Used for interior decoration. Weight, 42 lb. per cubic foot.

PURPLEHEART (*Peltogyne paniculata*). A wood which grows in the tropical localities of South America. It is a hard purple-coloured wood, with a beautiful lustre. Works well. Used for marquetry work and turnery. Weight, 50 lb. per cubic foot.

RASPBERRY-JAM WOOD (*Acacia acuminata*). An Australian wood bearing a scent like that of bruised raspberries. It is a dark reddish brown colour, with black streaks. Rather difficult to work. Used for ornamental cabinet work and turnery. Weight, 60 lb. per cubic foot.

ROSEWOOD, RIO and BAHIA (*Dalbergia nigra*). These two varieties of Rosewood grow in Brazil, the latter being the better of the two. It is a dark purple-brown wood streaked black, and possessing a weak rose-water scent. Both varieties are very close-grained and take a beautiful polish. They are used in the solid as well as in the form of veneers. The demand in recent years for this timber has declined very much, and although at one time fairly common has now become comparatively scarce. Weight, 60 lb. per cubic foot.

ROSEWOOD, INDIAN (*Dalbergia latifolia*). East Indian, Bombay Rosewood, and Bombay Blackwood are synonyms. This wood is similar in colour to the South American variety, but generally a little darker. This variety can be obtained in long lengths, and is also very wide. Used in cabinet work and for panelling. Weight, 50 lb. per cubic foot.

Sabicu (*Lysiloma sabicu*). This is a West Indian wood of dark brown colour, often with black streaks and fine figuring. It is hard, close-grained, and takes a fair polish. Used for internal fittings and decorations, and cabinet and furniture making. Weight, 50 lb. per cubic foot.

Sal (*Shorea robusta*). A Burmese hardwood used for tool handles. There is also an Indian variety. Weight, 60 lb. per cubic foot.

Salmonwood, Indian (*Eriolaena candollei*). This is also a Burmese wood of salmon-pink colour, and is very finely marked. Is hard, lustrous, and takes an excellent polish. Used for decorative cabinet work, and inlays. Weight, 51 lb. per cubic foot.

Sanders, Red (*Pterocarpus santalinus*). A dark claret-coloured wood of India, often almost black, and streaked with a deep violet colour. Valued as a wood for decorative cabinet work and inlays. Weight, 75 lb. per cubic foot.

Satin Walnut (*Liquidambar styraciflua*). The correct name for this wood is Gum, by which name it is generally known in North America, where it grows abundantly. Often called in England Hazel Pine, Sweet Gum, and Californian Red Gum. Actually it has nothing in common with Pine or Walnut. It is a pale reddish brown colour, close-grained and smooth, with a satiny sheen. It is notoriously bad timber for warping and twisting. Used extensively for cheap furniture. Weight, 40 lb. per cubic foot.

Satinwood, West Indian (*Zanthoxylum*). This wood, which is often finely figured, is of a rich light to golden yellow colour, which darkens with age. It has a very fine satiny lustre, and polishes most exquisitely. Used for the finest cabinet work and brush backs. Weight, 51–68 lb. per cubic foot.

SATINWOOD, EAST INDIAN (*Chloroxylor swietenia*). This variety comes chiefly from Ceylon and occasionally from India. It is used for similar purposes to the West Indian variety. Weight, 48 lb. per cubic foot.

SYCAMORE (*Acer pseudoplatanus*). This wood when stained grey is the commercial "greywood." It grows in Europe and is of a yellowish white colour, often well figured and lustrous. Used in the form of veneers and in the solid for panelling in railway coaches. Weight, 40 lb. per cubic foot.

TEAK, MOULMEIN, RANGOON, and BANGKOK (*Tectona grandis*). This timber comes from India, Burma, and Siam, and is of a yellowish brown colour, darkening with age. It contains an oil which acts as a preservative to the wood and renders it very durable. Used for many varieties of work, including railway coach building. Weight, 40 lb. per cubic foot.

One other variety, Java Teak (*Tectona grandis*) is similar to the Indian variety, but inferior. Weight, 43 lb. per cubic foot. A variety misnamed Borneo Teak is not a Teak at all, although commonly called so. The two former kinds have never been located in Borneo.

THINGAN (*Hopea adorata*). This wood is of a bright yellow colour and comes from India. It is straight-grained, similar to Mahogany, and of very similar texture. It is very durable, and an excellent wood for cabinet work. Weight, 40 lb. per cubic foot.

THITKA (*Pentace burmanica*). An Indian wood resembling Cedar, being of a light reddish-brown colour with a beautiful silvery grain. It is strong and durable and polishes well. Suitable for artistic decorative work. Weight, 44 lb. per cubic foot.

TULIP WOOD (*Physocalymma scaberrimum*). A Brazilian timber of rose-pink colour, often striped. Used for inlay and marquetry work.

An Indian variety (*Dalbergia oliveri*) is similar to the former, and is very hard and close-grained. Used for similar purposes as the Brazilian variety. Weight, 66 lb. per cubic foot.

TUPELO (*Nyssa sylvatica*). A North American wood often called a Gum. It is of a creamy yellow colour, inclined to bleach when exposed, and also to warp. Produces a very smooth surface when worked. Used in place of whitewood for general work, including parts of furniture. Weight, 40 lb. per cubic foot.

VENGAI (*Pteracarpus marsupium*). A golden yellow Indian wood with light and dark streaks, possessing a smooth, lustrous surface, often well figured. Contrary grain makes it rather difficult to work. Used for interior decoration and cabinet work. Weight, 55 lb. per cubic foot.

WALNUT (*Juglans regia*). This variety grows abundantly in Europe and Asia, and is of a greyish brown colour, often possessing fine figuring. It is hard, close-grained, and polishes well. Used for furniture making. Weight, 40 lb. per cubic foot.

WALNUT, BLACK (*Juglans nigra*). This is a chocolate-brown coloured wood of North America. It is inclined to darken with age, but is definitely more durable than the European variety, and is not so readily attacked by the wood-boring beetle. Weight, 40 lb. per cubic foot.

WALNUT, INDIAN (*Albizzia Lebbek*). This wood is a handsome brown colour streaked with yellow and black, often possessing extraordinary wavy marks and mottling. This wood is now in great demand for cabinet work and furniture, particularly for bedroom suites. It is generally cut into veneers for such purposes. Used also for turnery and all kinds of decorative work. Weight, 46 lb. per cubic foot.

WALNUT, INDIAN BLACK (*Terminalia tomentosa*). Similar to the above, but heavier and darker. Large quantities of this wood are now on the markets for use in cabinet making, furniture construction, and for musical instruments. Weight, 55 lb. per cubic foot.

Whitewood, Canary (*Liriodendron tulipifera*). This wood is often confused with a similar variety called Basswood, to which it has no relation at all. It grows in North America, and is called there by any of the following names: Tulip Wood, Yellow Poplar, and Poplar. In England it is known as American Whitewood, Canary Wood, and Canary Whitewood. It is a yellowish colour, sometimes with rich dark marks in it. It stains and polishes well, but shrinks and warps very much indeed. It turns a brownish colour with age. Used for cheap furniture, cupboards, mantel-boards, and for a variety of general purposes. Weight, 30 lb. per cubic foot.

Yellowheart (*Fagraca fragrans*). This wood grows in Burma and is of a light yellowish brown colour. It is close-grained, hard, and durable. Until recently it has not been used to any extent in this country, but quantities of it are now on the market, and undoubtedly this wood will appeal to cabinet makers as a splendid variety for cabinet work. Weight, 60 lb. per cubic foot.

Yellow Jackwood (*Artocarpus integrifolia*). This is an Indian and Burmese wood of rich dark or golden yellow colour. It appears to have a soft and a hard grain, making it rather difficult to work. However, it polishes well. Used for brush backs, turnery, and decorative work. Weight, 40 lb. per cubic foot.

Yew (*Taxus baccata*). A European and Indian wood, generally amber coloured, although some of it is much nearer to a reddish brown, and often well figured. It is close-grained and very hard. Much of it is cut into veneers for decorative work, and it is also used for furniture making, chair frames, and walking-sticks. Weight, 50 lb. per cubic foot.

Zebra Wood, Red (*Melanorrhoea usitata*). This is a very hard wood which grows in India, possessing a reddish colour with darker red or brownish streaks. Used for tool handles and decorative work generally. Weight, 56 lb. per cubic foot.

The varieties of timber referred to in the foregoing pages do not constitute an exhaustive list; it is, however, a comprehensive one.

Of the woods mentioned a number may not be familiar to some readers, but specimens will be found in any of the well-known timber museums, such as at Kew Gardens and South Kensington.[1] An observant reader will recognize many of them in the ordinary course of business or leisure.

A number of the varieties given are quite suitable for polishing in their natural colours, and do not therefore require staining.

The processes involved in the preparation of the surfaces for staining, and also the actual staining, will be given in detail in the following chapters.

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[1] Information relating to timber can be obtained from the Timber Development Association, 47 King William Street, London, E.C.4, or the Building Centre Ltd., 158 New Bond Street, London, W.1, and in some cases samples may be inspected. See also glossary by T. Corkhill now in course of publication in *Wood*; also Department of Scientific and Industrial Research publications: *Home-grown Timbers* and *Empire Timbers* (H.M. Stationery Office, Kingsway, London, W.C.2).

# CHAPTER II

## PREPARATION OF WOOD SURFACES

In order to achieve success in staining and polishing wood it should at once be recognized that a sound systematic procedure must be adopted, and carried through with thoroughness from beginning to end.

It naturally follows that the foundation must be properly laid, and hence it is of paramount importance to obtain a properly prepared surface on which to begin the finishing processes.

Any work direct from the cabinet or woodworking shop is invariably in an unsuitable condition to begin the finishing processes directly. Plane marks, scratches, knots, and other defects must always be very carefully removed or covered, and this point can hardly be overstressed. It is important to realize that tool marks and scratches which appear minute in the "white" (unpolished or unstained condition) are intensified in the staining and polishing processes, and hence special care is required on this fundamental operation.

**Scraping.** To remove roughness, tool marks, etc., a cabinet maker's scraper is an essential tool. It consists of a piece of sheet steel about 4½ in. × 2½ in. and 20 or 22 S.W.G. thickness. The corners of this piece of steel are often ground off to prevent digging in, and the long edges are used as cutting edges.

The cutting edges are set by sharply rubbing with pressure the back of a gouge or similar tool along the edge of the steel towards the body (in one direction only) so as to produce a burr on each sharp edge, care being taken to avoid too much rounding of the edge. It requires a good deal of practice to achieve success in setting a scraper.

The tool is used to remove a very thin shaving from the surface of the wood, which is accomplished by holding the scraper at an angle of about 45° to the surface of the wood, using both hands, with the thumbs pointing toward each other on the back of the scraper (Fig. 1). The cut is made by a slowish forward movement of the tool, that is, a movement away from the body and in the direction of the grain of the wood. Sufficient pressure must be applied to the scraper to remove a very thin shaving.

**Glass-papering.** Following the cleaning down by scraping, the final preparation of the surfaces is effected by the use of glass-paper. Two important points in this operation require emphasis.

In the first instance scraping is carried out to remove scratches and other defects, hence care must be exercised to avoid introducing fresh scratches and indents during glass-papering. Therefore to obtain satisfactory results and avoid these defects, fine glass-paper only must be used after scraping.

Generally speaking, two grades of paper are necessary, a No. 1 fine and a No. 0, the former being used for the first rubbing-down, and the latter for the finishing. In each case the glass-paper should be cut (not torn wastefully) into pieces of convenient size to fit round a cork block. All glass-papering of flat surfaces should be done with the aid of a cork block used as a backing for the paper. The function of the block is to prevent the wood from being indented and to maintain a level surface. Such blocks can be obtained for a few pence from any cabinet-makers' or carpenters' tool stores.

Secondly, unless glass-papering is carried out carefully, sharp edges and corners are apt to be taken off, thus spoiling the general appearance of the work. To avoid this defect, the use of a flat cork block is essential.

When glass-papering, an even and moderate pressure is

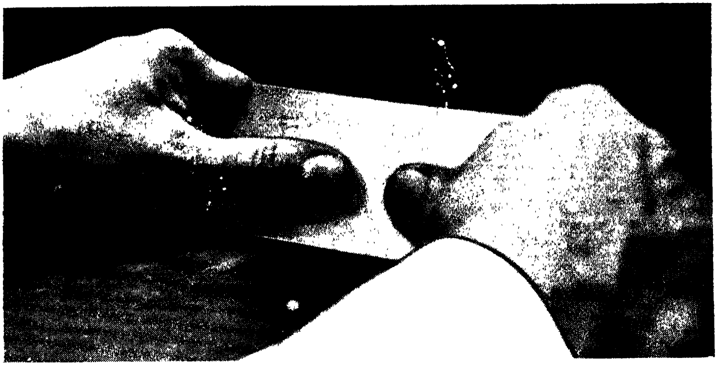

FIG. 1. THE SCRAPER

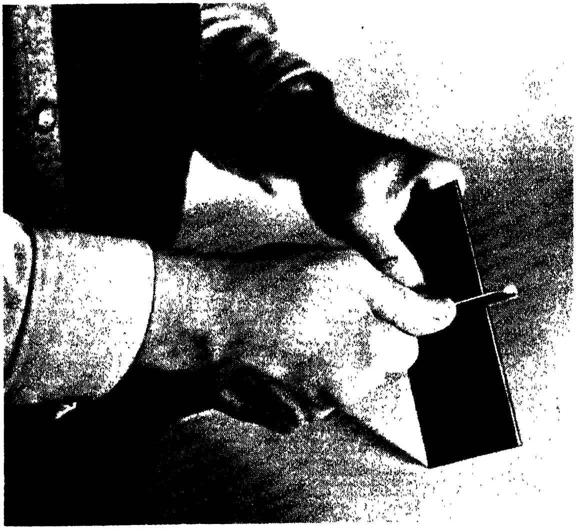

FIG. 1A. SETTING THE SCRAPER

required on the block, combined with steady reciprocating movement, working always in the direction of the grain. This latter point is important, since if the paper is used across the grain, scratches will result and the surface will come up darker when stained.

When dealing with turned parts, grooves, and shaped pieces, the flat cork block is of course unsuitable. It is useful in such circumstances to obtain a few curved or cylindrical pieces of cork or cork-faced wood to take the place of the flat block. Otherwise, exercising care, the fingers alone can be relied upon to give satisfaction after a little practice.

Finally, before glass-papering, dust off the surfaces thoroughly with a cloth to avoid the risk of foreign matter producing scratches, and again when the glass-papering is finished remove the wood dust with a soft cloth.

**Glass-paper Table.** The following Table gives the commercial grades of finishing paper obtainable, with the numbers by which they are graded. The strength of the abrasive increases as the numbers run from left to right.

| Quality | Grades | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flexible Cabinet Glass-paper . | Flour | 0 | 1 | 1½ | F2 | M2 | S2 | 2½ | 3 | | |
| Garnet Finishing Paper for use on mouldings, etc., where ordinary paper would be too stiff . . | 7/0 | 6/0 | 5/0 | 4/0 | 3/0 | 2/0 | 1/0 | | | | |
| Extra-quality Flint Paper for machine use . | 000 | 00 | 0 | ½ | 1 | 1½ | 2 | 2½ | 3 | 3½ | 4 |
| Extra-quality Garnet Paper for machine use | 4/0 | 3/0 | 2/0 | 1/0 | ½ | 1 | 1½ | 2 | 2½ | 3 | |

Referring to the two latter qualities, the flint is used for softwoods and the garnet for hardwoods. The papers listed above are manufactured by Messrs. John Oakey & Sons Ltd., London, who specialize in finishing papers for cabinet makers and french polishers.

**The Treatment of Grease and Black Surface Marks.** The need for removing grit and dust before and after glass-papering has been mentioned in a previous paragraph. While passing through the wood shops and during transport from one department to another, the work is always liable to become marked with oil or grease, while black marks such as soot stains have to be dealt with frequently. Grease if not removed will show itself when the work is polished, a defect known as "spotting" resulting from the presence of grease or oil under the polish. Hence before the preparation of a wood surface can be regarded as complete all trace of grease must be removed.

Glass-paper may be effective in the removal of grease which has not penetrated far into the wood. If this method is tried, only very light pressure on the glass-paper should be used. Intense local pressure may roughen the surface. To remove grease or oil which has deeply penetrated the wood, a liquid must be used. A piece of clean white muslin or linen rag soaked in benzine for preference or turpentine as a substitute should be rubbed over the grease marks. When performing this operation, work away from naked lights and keep the bottles well corked. Particular care is required when using the former, which is very volatile. After the application of the liquid remover the grain will in all probability lift, more so in some woods than others. Allow the work to dry thoroughly, then glass-paper down and finally dust off.

Excess glue should also be removed, as this also produces "spotting" when work is polished. Care should be exercised to remove even the smallest films or spots of glue on the surface to be polished.

Black marks on a surface resulting from the presence of foreign matter cannot generally be removed by glass-papering. Such treatment may in fact cause the mark to spread. Application of a little soapy water with a clean white linen rag can be recommended to remove black marks. After the mark has been so removed, wash away all traces of soap with clean water applied with a clean rag, after which the work must be left to dry thoroughly. This treatment will in most cases cause the grain to rise, which can be corrected as before by glass-papering. On thin pieces of wood in particular be careful not to soak the wood with water, as such treatment may cause warping.

**Filling Nail-holes, Cracks, etc.** The filling of nail-holes, cracks in the work, hollow places round knots, and indentations is effected by the use of stopping, of which there are two kinds in general use. One, known in some circles as Beaumontage, is a hard stopping, while the other, a softer variety, is called putty. Filling holes by puttying requires a somewhat different procedure from that required for hard stopping, and will be detailed in a later paragraph. Occasionally beeswax is used as a stopping material, but it is hardly satisfactory for general work, being suitable only for filling very small cracks, etc., since it does not set hard enough to withstand ordinary wear and is easily scratched or pulled out of the holes or indentations. It is as well, however, to have a small stock available for such minor contingencies as have been mentioned.

**Hard Stopping.** This is sold ready for use in sticks 9 in. or 10 in. long and in several colours, the sticks resembling common sealing wax. Generally speaking, hard stopping produces the best results, and a stopping of this character made by an expert craftsman is difficult to distinguish from the wood itself. To accomplish such results, however, very accurate colour matching is necessary, and in consequence most expert craftsmen make their own stopping. Hard stopping consists of a basic conglomerate of beeswax, resin, and orange lac in the ratio of 1 : 1 : 16 or 18 by weight, to which is added a colouring material to produce the required shade. The colouring materials are in powder form and obtainable in a variety of colours and shades. It is convenient to keep a stock of the basic material and to add the colouring materials as the need arises.

**Method of Making Hard Stopping.** Quantities of beeswax, resin, and orange lac in the proportions given should be melted down together in a suitable pot or metal ladle, using *gentle heat only and keeping well stirred.* It is very important that only a little heat be used, since if the materials are allowed to boil the stopping will be quite unsatisfactory. Too high a temperature produces brittleness and the stopping lacks power of adhesion; it would thus fall out of the holes on the slightest provocation. While the basic materials are in the molten state, add the colouring material and well stir it into the mixture. The most convenient form in which to use the stopping is in sticks about half an inch in diameter and 9 in. or 10 in. long. These can be made by taking a quantity of the mixture after it has cooled sufficiently to make it stiff, and rolling it out on a piece of sheet metal which has been slightly warmed.

The tabulation on p. 23 gives the colouring materials to add to the basic materials to obtain required shades of stopping.

**Stopping Holes and Indentations.** To use hard stopping, a flat strip of metal—an old file, with the cutting face ground off towards one end is very commonly used—should be heated sufficiently to melt the stopping when in contact with it. The tool should be held close to, and sloping towards, the hole to be filled, with the stopping wax in contact with the flat surface of the tool until sufficient has melted to fill the hole. An excess of stopping should be avoided, care being taken to clean

| Colour Required for Stopping | Add to Basic Materials |
|---|---|
| Black | Gas black. For blacking putty, use vegetable black. |
| Dark brown | Brown umber or vandyke. A little gas black may be a desirable addition. |
| Light brown | Yellow chrome and brown umber. |
| Medium brown | Brown umber. |
| Dark reddish brown—Purple-brown | Venetian red and purple-brown. |
| Dark red and red shades | Venetian red; gas black may be added if required. |
| Deep yellow | Yellow ochre. |
| Pale yellow | Yellow chrome. |
| White | Powdered whitening and a little ultramarine blue. |

off the surface perfectly level with glass-paper when the stopping is thoroughly hard. The use of a lighted match or taper as a means of melting the stopping is deprecated, since discoloration of the material is liable to result and the temperature may very well be too high.

To fill small and smooth indentations and similar defects it is necessary to form a key to hold the stopping. This is conveniently done by making the hole deeper with the aid of a drill or bradawl so that sufficient stopping can be applied to secure a hold. The filling can then be carried out as directed above.

Hard stopping is in general soluble in methylated spirit, and hence a too liberal application of spirit should be avoided on work which has been stopped with this material.

**Puttying.** This may be regarded as a general term assigned to filling holes, etc., by the use of soft stopping, of which there are several varieties. These may be roughly divided into two groups, of which one is suitable when the work is to be oil stained and the other when water or chemical stains are to be used. Puttying is a somewhat delicate process, as a minimum amount of material must be used and every effort made to keep it from being smeared on the surface of the wood round the hole or indentation which requires filling. Any surplus putty not properly cleaned off will produce undesirable results in the finished product, such as spotting and uneven colouring due to the blocking of the pores of the wood locally, thus preventing even absorption. If the work is not to be polished, then puttying is usually done prior to staining, otherwise it is done after staining.

In the latter case great care is needed to prevent smearing, otherwise spotting will result when the work is polished; while in the former case local discoloration may result from the same cause. Therefore only just sufficient stopping should be used to fill the hole, and a proper puttying knife used for the process, the putty being deposited carefully in the hole.

When the work is to be oil stained, oil putty can be used, while a mixture of finely ground plaster of Paris (dental variety) mixed with ground whitening is suitable for work to be water or chemically stained. The whitening and plaster should be mixed in the ratio of about 2 : 1 by weight, with a little polish and colouring powder to give the required tint to match the wood.

## SURFACE DRESSING

This process should not be confused with that of grain filling, which is carried out for an entirely different purpose and is detailed in the next chapter. Softwoods in particular often present, when under preparation for staining and polishing, surfaces having a varying density or closeness of grain. This characteristic will be revealed by the presence of soft patches which show up darker in colour than the rest of the work after staining. This defect is due to unequal absorption of the colouring material, and it is with the object of preventing this that a dressing is given to all such wood surfaces having grain of apparently varying density. Staining is only really effective when absorption by the wood is uniform over the whole surface, and dressing should only be resorted to under the conditions stated. It must not be used when the work is to be chemically stained.

**Glue Size.** For general purposes glue size is the most useful dressing, and it is cheap; but the strength of it varies considerably, according to the particular maker. Both from the point of view of uniform strength and ease of storage one of the powdered forms of size is strongly recommended. Either Beta or Cannon's size, which are sold in 4 oz. packets, can be relied upon to give consistently good results; the size is in concentrated form. To achieve good results it is important that the size should not be too strong when applied to the surface, as under such conditions it will lie on the surface and cause any covering coats to peel off. A solution of suitable strength for most purposes can be made by adding one quart of water to 2 oz. of concentrated size. The strength does, however, require some adjustment to suit the condition of the wood, a particularly spongy piece needing a stronger solution. In general, use weak solutions. For the preparation of the size an earthenware pot or metal receptacle should be used, into which the requisite amount of powdered size should be placed and covered with sufficient cold water just to soften it. Before the wetted size has had time to stiffen, boiling water should be added. For dressing a surface the solution should be applied while warm, using a soft brush for the purpose and applying sparingly. Any excess solution which may collect in mouldings, recesses, or decorative work should be cleaned out before the size sets. When the work is dry it should be rubbed down with a fine glass-paper.

**Gold-size and Turpentine.** Any very spongy or sappy wood may be dressed with a mixture of equal proportions of japanner's gold-size and best American turpentine. The mixture should be applied thinly with a brush.

**Oil Varnish.** For work which has to be oil stained a very good dressing can be made by thinning down hard varnish with best American turpentine. Spirit varnish should not be used as a dressing for general work, although it is occasionally used for some of the harder woods. Peeling often results after the use of this kind of varnish as a dressing.

# CHAPTER III

## FILLERS AND FILLING

FILLING is a process employed to stop up the pores of the wood so as to avoid an abnormal absorption of polish, and to secure an unbroken level surface ready to receive the stain or polish. This process is essential if a continuous unbroken surface is required in the finished article.

It is evident that open-grained woods such as ash, elm, and some varieties of oak would require many more coats of polish than a close or densely grained one, so much so that an abnormal amount of material and labour would have to be expended before a satisfactory finish could be obtained. Hence to obviate such conditions some kind of filling is essential. A few of the harder woods, such as some kinds of box, satinwood, maple, and holly, can be well polished without a filler. Of the commoner varieties, mahogany, padouk, and walnut are invariably filled, although these woods have in general medium grain. As a general rule, filling is necessary in practically all varieties of timber. In certain cases the open grain of oak, for example, is preferred in the finished article. If such is the case, then no filling is of course needed.

The filling of the grain can be carried out before or after staining, but in certain instances it *must* be done afterwards. For example, in fumed oak work the fuming has no effect on the colour of the filler, therefore it is obviously easier to match it to the colour of the fumed wood afterwards.

**Application of Fillers.** Broadly speaking, filling consists of rubbing a suitable medium into the pores of the wood with the aid of a brush or piece of rag, working always *across* the grain, and cleaning off surplus material when finished, the latter being an important operation which should be performed before the filler has had time to dry. When thoroughly hard the surface must be glass-papered down, in the direction of the grain, with a fine paper suitable to produce a smooth, flat finish without disturbing the filling.

In the filling process as well as in staining, an æsthetic taste can play a very prominent part, for often very striking effects can be obtained by the careful use of fillers coloured in contrast to the wood. The modern form of weathered or limed oak, in which a white filling is used, is an example of this, the wood being stained a brownish colour. In many cases where such contrasts are desired, a transparent filler can be mixed with a dry colouring medium. This produces a filler which allows the natural colour of the wood to be retained, while the pores are blocked with the coloured filling, thus producing the required contrast. Similar results can be obtained by first staining the wood and then applying the coloured filling in the ordinary way, care being taken, of course, to avoid shifting the stain.

For experimental purposes it is always advisable to have a few spare pieces of wood on which to test colourings for desired effects. Undoubtedly this is an essential and important section of the work, and in the light of modern tendencies provides a certain amount of scope for the artistic eye.

## FILLERS IN GENERAL

Roughly, fillers can be divided into two groups: (*a*) those used in liquid form having gum or shellac as a base, and (*b*) those used in the form of paste, having plaster of Paris as a base. It is generally accepted that filling by repeated applications of polish as suggested by (*a*) is the best method, although more costly both in material and labour, and greater skill is required in execution. This method is known as *direct filling.*

By far the most common method of filling is that involving the use of a paste in which plaster of Paris is the principal ingredient. Other fillers can be made with whitening or wax, while fillers having a vegetable material as a base are occasionally used, though they are not recommended.

Most craftsmen make up their own fillers, but there are numerous proprietary ones on the market, most of which only require mixing with turpentine or methylated spirit to prepare them for use. As in the case of stopping wax, however, correct matching is not always possible if ready-made filling material is used, and hence the following information relating to the making of fillers will be found useful.

## FILLERS IN PARTICULAR

**Direct Filling.** This method consists of repeated applications of diluted polish and pumice powder, and introduces the necessity for a *pounce bag*, a description of which at this stage seems appropriate.

A pounce bag consists of a piece of soft muslin cut square which is laid flat on the bench. The requisite quantity of fine pumice powder is then placed in the centre of the muslin square, the corners of which are then gathered up and tied with a piece of thin string so that the powder enclosed forms more or less a ball, which, when pounced on the wood surface, scatters a little of the pumice powder over the surface. The size of the bag required varies according to the work, but a little powder goes quite a long way, and on small cabinet work a piece of muslin 5 in. or 6 in. square and a tablespoonful of pumice powder should be adequate.

Before the filling process is actually performed it might be considered desirable to enhance the figure of the wood. This may be accomplished by the application of a little raw linseed oil, using a piece of clean white linen rag for the purpose. Occasionally, if the wood is of a reddish colour such as padouk or mahogany, red oil is used for improving the appearance of the grain. Red oil, however, stains the wood and hence should be used with caution, as undesirable colouring may result. In any case, whatever oil is used it *must* be used *very sparingly*, otherwise defects may occur in the finally polished surface due to an excess of oil having been used. Having given the surface an application of oil, ample time must be allowed for it to dry, say an hour or so, after which a start can be made with the filling process.

Although not universal practice, it is desirable to use diluted polish for direct filling, the polish being thinned slightly by the addition of a little methylated spirit. A coat of the diluted polish should then be given to the work, either with a stiffish brush or an old rubber. The former tool is preferable for the first coat, since it tends to force the polish into the grain rather more than does the rubber. Whichever tool is used, the filler should be worked in *across* the grain, and some ten or fifteen minutes allowed for the first coat to dry in. An additional two or three coats of diluted polish should then be given, using an old rubber and allowing time between the application of the coats for drying. All the filling so far applied will probably be absorbed by the wood, depending, of course, on the condition of the grain of the wood. After the third or fourth coat, however, the work should be set aside for an hour or two to harden.

The next stage introduces the pounce bag, and after scattering a little pumice powder over the surfaces by repeated applications of the bag it should be worked into the grain by applying a mixture of about equal portions of polish and methylated spirit. To work the pumice powder effectively into the grain, an old polishing rubber is most useful. After charging the rubber with the diluted polish it should be worked across the grain with a circular or figure-of-eight movement, applying light pressure only to the rubber. A detailed description of the rubber and the method of using it is given in the chapter on French Polishing.

Repeated applications of polish and pumice powder may be necessary, depending entirely on the condition of the grain, the open-grained woods requiring more filling than the closer-grained ones. The process should be continued until the rubber shows signs of sticking, when work should be suspended for some ten or fifteen minutes to allow time for the filling to dry. Inspection of the surfaces being treated should indicate whether the grain has been completely filled; if not, work should be continued on the lines indicated. When eventually the grain has been satisfactorily filled, the work should be set aside for some eight or twelve hours to allow the filling to harden thoroughly. The work should then be glass-papered down perfectly level, using a fine-grade paper, after which it should present a smooth and unbroken surface with a dull appearance. A word of warning is needed here in reference to the glass-papering. To prevent the polish picking up, as it may tend to do, a very little linseed oil applied to the abrasive with the tip of a finger is necessary, but only a very little oil should be used, for reasons already referred to.

When filling white wood by this method and the whiteness is to be preserved, then it is necessary to use white polish and a white filler.

**Paste Fillers.** Plaster of Paris is the chief constituent of a series of fillings which may be given the general name of paste fillers. In all cases where it is intended to use plaster of Paris, the variety used by dental mechanics is the best. This is very finely ground and is superior to the common varieties used in rough plaster work, which invariably contain other inferior material and are much coarser. To convert the plaster into paste, water or methylated spirit is commonly used, although the latter is to be preferred. Water tends to raise the grain rather more than the spirit and involves therefore a greater expenditure of labour in glass-papering to recover the flatness of the surface accompanied by the risk of disturbing the filler, or even rubbing it out of the grain. It should be realized here that plaster of Paris has an affinity for moisture, and the presence of moisture in turn causes the plaster to become hard and lumpy. Hence the method of applying this type of filling, and all those having plaster as an ingredient, is important. The plaster should, of course, be stored in a dry place, preferably in an airtight canister or wooden box. When applying the filling an old rubber, or better still a pad of coarse undyed rag, should be used. This should be kept moist with spirit (or water) and a little plaster sprinkled on to either the pad or the work. The filler is then rubbed well into the grain, working *across* it, recharging the rag with spirit when necessary, and adding the plaster accordingly. The plaster should never be mixed with the spirit to form a mass of paste, as this rapidly hardens and becomes lumpy, a condition which is fatal to good work.

Any surplus filling must be wiped off the work, and when the grain is satisfactorily filled it should be allowed a period of eight to twelve hours to harden, after which a light rubbing-down with flour glass-paper should be given, working, of course, *with* the grain. When filling coloured woods such as the yellow and brown varieties it is necessary to colour the filling to match. For this purpose one of the dry pigments given at the end of this chapter should be mixed with the plaster before moistening.

**Whitening Filler.** Finely powdered whitening to which must be added a little fine pumice powder is occasionally used as a filling. It can be coloured to match various woods by the addition of a pigment as in the previous recipe. The ingredients are mixed into a fine paste by adding best American turpentine. It is rubbed into the pores of the wood with a coarse rag, working *across* the grain. This is a cheap filler, but does not harden to the same extent as plaster. With a light colouring agent this filler is useful for the closer-grained and paler-coloured woods.

**Crystal Silica.** This material finely ground is sometimes used as a base to which a binding material such as plaster of Paris is added, together with the requisite colouring material. This filler is applied in the manner already described for paste grain fillers.

**Patent Fillers.** Several of these are now procurable, and some are made particularly for the special finishes now being used. For cellulose finish, for which it is recommended, Wheeler's Wood Filler is often used. Another filler recently introduced considered to be superior under cellulose is known as "Duglo," and is obtainable in transparent, walnut, and mahogany shades.[1]

PIGMENTS FOR COLOURING PASTE GRAIN FILLERS

| Wood to be Matched | Pigment to Use |
|---|---|
| Ash, birch, elm, maple, oak, satinwood, and others of similar colour | Yellow chrome or yellow ochre |
| Black walnut and very dark red woods | Venetian red with gas black to suit |
| Dark brown woods such as teak and walnut | Brown umber |
| Ebony | Gas black |
| Mahogany, etc. | Venetian red with a little vermilion if thought necessary |

The above are typical colourings which can be varied by using correct proportions of plaster, etc., and the pigment. Required colourings can be found by experiment.

**Spirit Varnish Filling.** The modern demand for rapid production and cheapness which has become so evident in many trades has, of course, had its effect in many ways in polishing and finishing. Hence it has become necessary to make use of a filler which will give rapid and effective results. To meet such demands a spirit varnish is generally used. These varnishes, by virtue of the higher proportion of gum which they contain compared with that of french polish, rapidly fill the open grain of the wood. In addition, quick drying is secured by using alcohol in place of methylated spirit as a solvent, the former being more volatile than the latter. Care is needed in applying spirit varnishes, as they are very apt to form local ridges due to the spirit partially drying out and leaving thickened gum, which the brush fails to distribute evenly. In the trade such uneven surfaces are described as "ropy." Spirit varnish when used for the purpose described should be applied with a soft-hair mop of the type referred to in the chapter on Brushes.

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[1] This is an American product obtainable from the sole agents for Great Britain, Messrs. Gedge & Co., St. John Street, London, E.C.1.

The foregoing process is that used in cheap-grade work and combines filling and varnishing. It should not be mistaken or confused with a properly polished surface.

**French Polish and Spirit Varnish.** For such purposes as those referred to in the previous paragraph a mixture of these two solutions is commonly employed. Either a brush or a rubber is used for applying the mixture, usually the former for the first coat or two, which serve to fill the grain. When the grain is satisfactorily filled, i.e. when absorption ceases, a good surface can be rapidly produced and one which can be readily polished. To apply polish and varnish solutions successfully, the rubber, used after the brush has been dispensed with, should be kept well charged with the liquid and time allowed for each coat to dry well before applying another. Polish and spirit varnish solutions vary somewhat in their respective proportions, but usually brown spirit varnish and french polish are mixed in the ratio of 1 : 3 or 4. A light-coloured solution can be made by substituting, say, a white varnish for the brown. There are, in fact, between twenty and thirty different kinds and qualities of spirit varnish.

Such methods of filling and finishing as given in the last two descriptions are easily detected by an experienced eye when examining finished work. They do not, of course, produce finishes to be compared with paste-filled or directly filled surfaces, properly french polished. They neither wear so well nor have the same refined appearance.

**Oil and Tallow Fillers.** For white and light-coloured woods either of these two fillers may be used. The former consists of a putty made by mixing china clay with a little driers, to which is added boiled linseed oil sufficient to produce a stiffish paste. The paste is thinned down with turpentine and applied with a rag in a similar manner to the paste fillers described previously. Alternatively, a brush is sometimes used, the filler in either case being well rubbed in by working *across* the grain.

Best Russian tallow mixed with whitening or plaster of Paris makes another filler which is occasionally used, but this does not harden sufficiently to be of great service, but is used sometimes when white work is to be wax finished. It is also used when light-coloured woods are to be french polished.

**Gold-size Filler.** Gold-size fillers, although a little more expensive than most of those already described, are very satisfactory, since they harden extremely well. Equal proportions of whitening and plaster of Paris should be mixed with any suitable colouring pigment and made into a rather thin paste by the addition of a little American turpentine. By mixing into the paste a little gold-size the necessary binding is given to the mixture, which will also have good hardening properties. The mixture thus obtained should be of the consistency of fairly thick paint, which can then be applied with a brush and worked into the grain by the aid of a coarse rag, surplus material being carefully cleaned off before setting aside to harden.

Summarizing the foregoing paragraphs, it should be clear that the application of paste fillers is much the same in all cases; broadly speaking, experience will provide the best guide as to the most suitable kind of filler to use for any particular purpose. Finally, in regard to plaster and whitening, it should be appreciated that these two substances have an affinity for water. Therefore only dry powders of each should be used, care in the storage of these being particularly important. Any of the foregoing fillers are suitable for work which has to be french polished.

## FILLERS FOR SPECIAL PURPOSES

**Filler for Spirit Enamelling.** Spirit enamelling is a special process to be described in a later chapter, but instructions for filling wood which is to be finished by this process will be given here. For this class of work a paste filler is usual, made up by mixing glue size and fine whitening to form a *thin* paste having a viscosity similar to that of paint. Picture mounters' size is perhaps better than glue size, as it is almost colourless. The filler should be applied thinly while warm, using a brush for the purpose and remembering that two or three thin coats are far better than one thick one. Time must be allowed between the coats so that each can dry, the filling being continued until a smooth and dense surface is procured. A filler such as that just described is suitable for white spirit enamelling, while the addition of some colouring pigment may be made to produce any required shade for a particular finish.

**Filling for Light Ornamental Work, Loud-speaker Fronts, and Fretwork.** Any light and thin pieces of work need careful treatment in the hands of the polisher. Excessive wetting must be definitely avoided, as the work will twist and warp if so treated, and may very well be ruined. Dark woods may be given a meagre application of boiled linseed oil, or alternatively the lighter varieties should be similarly treated with raw oil in the manner previously described. This will improve the appearance of the grain, after which a paste filler can be used. In light work of this sort a tallow filler which is comparatively dry is particularly useful and will give satisfactory results:

this filler has been described in a previous paragraph. In general for this class of work avoid excessive wetting, in order to reduce risk of distortion; also care should be exercised to prevent excessive filling and other material collecting in corners and ornamentation generally.

**Filler for Turnery.** Such articles as tool handles, turned parts of furniture, musical instruments, and knobs are commonly polished in the lathe. Large turned fitments of furniture are not usually polished in the lathe, although if the design is a plain one there is little reason why such pieces should not be so treated. Any work which has come from a machine in the first instance is liable to have machine oil on it, which must, of course, be entirely removed by the processes described in the previous chapter. The grain of turned work can be improved by rubbing a little linseed oil into it with the aid of a piece of rag, using boiled or raw oil according to the colour of the wood. For filling, any of the coloured whitening fillers already described will be suitable. For the very hard woods, however, no filling should be necessary.

**Fillers for Inlaid Work.** This class of work is not so fashionable nowadays, but for small articles such as trinket boxes, needlework cabinets, and the like there is still a market. Much of this work is veneered, and as such does not need any filling, the pores of the wood being completely blocked by the glue which holds the veneer to its backing. The surrounds of inlays and the groundwork for transfers will, however, generally require filling, for reasons already referred to, and in performing this operation on inlaid work great care is required to prevent either filling or stain encroaching on the inlays or transfers and discolouring them. A direct filling can, of course, be used for groundwork by employing a transparent polish if there are colours in the inlays contrasting with the ground part, as there probably will be. Otherwise a whitening paste filler previously described is suitable when coloured to suit the natural or stained colour of the groundwork. As a protection for the inlays during the staining and filling of the groundwork or surround, one or two fairly heavy coats of polish should be given to the edges of the inlays and transfers, cutting in the edges carefully with a small brush. When the filling is thoroughly hard, the polish used as a protection can be removed by carefully washing off with methylated spirit; better still, fine glass-paper may be used to remove it.

The foregoing remarks apply equally well to inlaid work and marquetry in general, but the type of inlaid work known as intarsia needs special consideration. Usually in this work a number of different woods are used to produce a picture, each having a different colour and type of grain. In applying fillers to this class of work care is needed to avoid eliminating certain effects from the picture produced by the grain of the wood for which it was particularly selected. A smoke effect or the ripples on the surface of water might be taken as examples, in which case the grain producing these effects must not, of course, be filled. Therefore it may be desirable to fill some of the woods in the picture and leave others. In any case, when different-coloured fillers are being used to match the different woods used in the composition, a protection for those to which the filler is inapplicable must be provided. This protection can be afforded by varnishing the edges with spirit varnish and when the filling is hard cleaning off the protection as described in the case of plain inlaying.

## OTHER RECIPES FOR GRAIN FILLERS

It is now proposed to give typical examples of grain fillers, and the method of manufacture, to suit some of the commoner varieties of wood. As a general rule. those woods having coarse open grain need a more viscous filling than those having close grain. Although particular examples of wood have been selected, all those possessing similar grain conditions to those quoted can be treated with the same kind of filler coloured to match the particular wood or colour of the finish required.

Ash. This wood, which possesses a somewhat open grain, requires a paste filler of a light fawnish colour, silica being used as the basic material. Mix in the ratio of 3 : 2 : 1 (by volume) gold-size, raw linseed oil, and best American turpentine. Precipitate fine silica to the gold-size and oil to make a paste, adding the turpentine as a thinner.

Beech. A hard, close-grained timber such as beech is best filled directly with transparent polish or with heavy white polish. As an alternative 1 oz. of white lac may be dissolved in half a pint of methylated spirit (*pro rata* for larger quantities).

Ebony. A dense black is generally required for ebony, although ebony is by no means always black. A paste filler is commonly used consisting of fine plaster of Paris, of the kind used by dental mechanics, to which should be added gold-size and a quantity of gas black. Use this mixture as a rather thin paste.

Elm. This is a rather open-grained wood, and may be filled adequately by a paste filler consisting of silica coloured slightly with a yellow pigment. Alternatively, whitening and plaster of Paris may be used in place of the silica. The filler should be applied with a rag, using methylated spirit for wetting it.

Mahogany. A light rubbing of red oil may be given before filling, as directed in the previous paragraphs. The grain is of medium character in good-quality timber, and may be directly filled with button polish. Alternatively, a paste filler will be found useful when the grain appears more open. A good filler can be made by taking turpentine, boiled linseed oil, and japan in the ratio of 3 : 2 : 1 (by volume) and adding plaster of Paris, fine pumice powder, and litharge in equal proportions (by volume), and mixing to form a paste. This should be well ground down, the addition of a little rotten stone (Tripoli or Tripolite) assisting to produce a fine paste. The addition of colouring pigments such as vandyke brown, brown umber, and purple-brown may be used to produce any desired shade of colour. As mahogany is extensively used, a number of patent fillers are marketed. Exact colour matching is, of course, more difficult with these.

MAPLE. This being a hard, close-grained wood is conveniently filled directly, using light transparent polish or white polish.

OAK. A fairly open-grained wood requiring a paste filler. The colour of the filler can be varied according to the finished colour of the work. A good general filler can be made by mixing whitening and plaster of Paris in the ratio of 5 : 2 (by weight) with raw linseed oil and best American turpentine to form a stiffish paste. The addition of a little white lac dissolved in methylated spirit assists as a binder. The raw linseed oil and turpentine may be in the ratio of about 4 : 1 (by volume). As an alternative, fine silica, japan or gold-size, turpentine, and raw linseed oil make a good filling for oak if mixed to a stiffish paste.

OAK, JACOBEAN or DARK. This indicates an adjustment of colour only to a paste filler such as has already been described. A paste filler such as plaster of Paris can be coloured with brown umber or vandyke, adding gold-size as a binder.

OAK, POLLARD or GOLDEN. A paste filler can be used for this particular colouring, the colour being obtained by the addition of brown umber. The latter will be required in considerable quantity if plaster of Paris is used for the filler. The paste should be made by adding about a gill of asphaltum varnish to 4 lb. or 5 lb. of the mixture. This kind of oak finish is not now in fashion, except for very special work.

PADOUK. A filler as described for mahogany is suitable if Chinese red and brown umber as a colouring is substituted for the pigments given for the mahogany filler.

PINE. A good filler for pine can be made by dissolving white lac in methylated spirit. Size is sometimes used, but the former gives better results.

Satin Walnut. A close-grained wood which can be filled with glue size or white lac dissolved in methylated spirit.

Sycamore. A fairly hard, close-grained wood which can be directly filled by applications of white polish. If the wood is to be slightly darkened, an orange lac dissolved in methylated spirit can be used.

Walnut. This wood is now much to the fore, both for furniture and railway coach interior decoration. A paste filler is most suitable, consisting of plaster of Paris coloured by the addition of brown umber and gold-size added as a binder. Thin down with turpentine and boiled oil in the ratio of about 2 : 1 (by volume). Alternatively, burnt Turkey umber ground in oil with terebine and turpentine added in the ratio of 1 : 2 (by volume) gives a good filler.

Having considered filling in detail, the next processes to be described are staining and dyeing, to which the next chapter has been devoted.

# CHAPTER IV

## WOOD STAINING

With the aid of stains it is possible to imitate the colour of various expensive woods, making cheaper varieties thus represent superior kinds, and to change a natural colour to give some particular effect. It follows that a knowledge of the appearance and particular features of the grain and general characteristics of different woods is essential, both to enable imitations to be made and also to be detected. In addition, experience in woodwork and the finishing processes is essential, and in this latter respect no amount of reading can produce the same impressions or enable one to acquire the requisite skill necessary to ensure success. A study of the previous chapters will give a comprehensive indication of the lines on which the worker should proceed. Further, it is essential for the cabinet maker or woodworker to be able to select varieties of cheaper wood suitable for staining to imitate the more expensive kinds. Such skill demands, in addition, a knowledge of the principles involved in staining and polishing and the results which it is possible to achieve. Cheapness in certain grades of furniture is made possible by the use of stained wood, and if skilfully carried out, stained work can be quite handsome and a worthy product of the best craftsmanship.

In the art of staining and polishing many beginners, and others for that matter, fall far short of real success, due chiefly to ignorance or disregard of essential and fundamental details. Nothing looks worse than a daubed and unevenly stained surface, and good woodwork is often spoiled by inferior finishing.

In this section of the work it is fundamentally necessary for success to select suitable wood for the treatment intended, and then prepare it for staining and polishing by the methods already given in the preceding chapters.

Staining must not in any way be confused with painting or any of the processes allied to it. The aim in staining is definitely to preserve the appearance of the grain of the wood, and enhance it rather than cover it up, as in painting. The varying density of the grain of a wood often enables striking shade effects and contrasts to be produced. These effects arise because of the varying degrees of absorption of the different parts of the grain. Again, in the selection of the colours of stains and dyes, an aesthetic taste is invaluable, and plays a prominent part in competitive work in particular.

Although hardwoods are invariably used in cabinet making, certain parts of a cabinet or piece of furniture on which carving may be necessary may be made of other kinds of wood more suited to the peculiarities of the carving process. Such parts will invariably require staining to match the general tone of the work. Similarly fretwork overlays, and fretwork in general, although not in great demand at present except in isolated cases such as loud-speaker fronts and parts of gramophone cabinets, are often made of wood different from the main structure. Here again staining in all probability is necessary to match up to the rest of the work.

Generally, the lighter-coloured varieties of timber are used for staining, although of course the natural colours of such woods as oak and mahogany are often changed by staining to produce some desired effect. Fashion plays a prominent part in furniture manufacture, which in turn is to some extent controlled by supply and consequent cost of production. At the present time, for example, limed oak, Jacobean oak, and walnut are fashionable, while Chippendale and Sheraton mahogany are for the time being, perhaps, not in vogue. Change of fashion is to a large extent made possible not only by the skill of the furniture designer, but also, to a considerable extent, by that of the polisher skilled in the use of stains and dyes, and in the production of grain contrasts and effects.

## VARIETIES OF WOOD SUITABLE FOR STAINING

**Ebony.** This wood, being expensive and somewhat difficult to work, is frequently imitated. Real ebony, however, machines well, and is consequently used for turned work, and provides a good finish. Mahogany and dark American walnut are commonly used as good imitations, the grain being well filled with a densely black filler, the surfaces afterwards being ebonized. Canary whitewood is occasionally used, although not one of the best woods for the imitation of ebony. Chestnut, cherry, hazel, pear, and sycamore are also used, and are more suitable for ebonizing than canary whitewood. Dark holly, although rather scarce, is also occasionally used. Its weight and grain closely resemble that of ebony.

**Mahogany.** The best imitations of this wood are made by staining beech and birch, which when well coloured closely resemble mahogany in general appearance, the specific gravities also being similar. Both canary whitewood and basswood are occasionally used for cheaper work, since they stain easily and well. A good deal of so-called mahogany is really an African baywood, which is lighter in colour than the true mahogany. This wood when stained and polished is difficult to detect, and is thus readily accepted as the real thing.

**Maple.** Yellow pine when treated with a few coats of light varnish is a good imitation of maple. The particular variety of the latter, known as birdseye maple, commonly used for decorative panels in coachwork, can be cleverly imitated by using a special brush known as a maple stippler. By manipulating the stain with this tool, pleasing effects can be produced.

**Rosewood.** This wood is not in much demand nowadays, being expensive and somewhat scarce. It can be imitated by staining close-grained mahogany or birch.

WALNUT. To imitate walnut, canary whitewood is very useful, being free from knots and possessing a sufficiently even grain to make absorption fairly uniform. As an alternative, basswood serves the same purpose. Both of these woods, however, shrink a good deal and are liable to warp and twist. Nevertheless, a great deal of these two varieties is used. Unfigured walnut is fairly well imitated by staining pine, often producing quite good effects.

Fuming, i.e. the transformation of natural colour by exposure to powerful fumes, is applied only to oak and mahogany, the former more than the latter.

For dyeing, sycamore is a very useful wood, and is most suitable for dyed veneers, for which it is fairly commonly used. Beech also stains and dyes well, so also do ash, boxwood, hazel, maple, poplar, oak, satinwood, and yellow pine.

## STAINING PROCESSES

There are at least six or seven staining processes, namely, water staining, spirit staining, oil staining, varnish staining, chemical staining, and wax staining. In addition to these, water coating may be considered as a method of colouring rather than staining, being a process similar to that adopted by decorators and known as colour washing or distempering.

The two most popular varieties of stain are water and spirit stains, while those in which naphtha is used as the solvent are also popular, being very quick-drying. These varieties of stain can be purchased ready-made from any wood finisher's stores, and are sold in a variety of standard colours such as mahogany, oak, and walnut, while spirit stains can be obtained also in special colours. In the naphtha stains a very comprehensive range of colours is available to meet the most modern requirements. Ready-made stains are advantageous inasmuch as they are prepared to a standard colour chart and can be relied upon to come up to the same shade of colour consistently if procured from the same source of supply. As a general rule, spirit or naphtha stains are preferable to water stains, since, being more volatile, the grain does not tend to rise so much as in water staining.

**Spirit Staining.** The use of methylated spirit as a solvent or liquid ingredient of stain is common, and the advantages of spirit staining have already been referred to. In addition, some colouring materials more readily dissolve in spirit than in water, hence the importance of spirit in such cases.

Spirit stains are obtainable in standard colourings, such as ebony, mahogany, oak, walnut, etc., but can be made from any of the dyewoods, aniline dyes, some of the metallic salts, and vegetable dyes. Spirit staining is akin to oil staining in many respects, although special care is needed in the use of the latter, for which hints are given under the appropriate heading.

**Water Staining.** As already explained, water stain consists of a colouring material with which water is used as the solvent so as to produce a transparent solution. In all water stains the colouring medium must, of course, be soluble in water, and leave no solid matter in suspension. The usual colouring media are selected from materials having both vegetable and mineral bases, for example the bark and berries of trees and plants on the one hand, and umber, sienna, gamboge, and indigo on the other. Water stains are not as a general rule so powerful as spirit stains, and hence more than one application may be necessary to reach the required depth of colour. As previously stated, water staining tends to lift the grain, particularly in some varieties of wood, and hence if several applications of stain are required, the work must be glass-papered down with fine glass-paper between each coat, allowing, of course, time for the stain to dry before this latter operation. Glass-papering will, of course, invariably have the effect of reducing the colour, hence light working with fine abrasive is essential. Other methods of checking the grain rising during water staining are often used, such as forcing it up by damping prior to staining, allowing the wood to dry, and then glass-papering. This method is suitable when only one or two coats of stain are to be applied. When preparing the surfaces for staining and polishing, fine glass-paper only should be used, since the coarser abrasives tend rather to open up the grain and cause it to rise when wetted. Craftsmen often have their own particular secrets for dealing with this contingency, some glass-papering between coatings of stain before it is quite dry. Such practices need considerable skill for success, and are not recommended to the inexperienced. In no circumstances should artificial drying be resorted to during staining.

The use of both water and spirit stains when applied to resinous woods often produces very striking effects, particularly in the case of the former. The more absorbent parts of the wood give a depth of colour greatly in contrast to the less-absorbent resinous portions, and in the best work there is no doubt that the water and spirit stains are the most popular.

**Water Stain Suitable for Varnish Finish.** Ordinary painters' dry colours and water with size as a binder makes an excellent cheap stain for a varnish finish. Such a stain is, however, unsuitable for use when a french-polish finish is desired. The stain having size as a constituent must be applied while warm with a stiffish brush. A flat one is generally preferable to a round one. The quantity of colouring ingredient must be adjusted according to the shade required, and, as a rough guide, about 8 oz. of size to 1 quart of water will be necessary. The amount of size required must be adjusted so that the mixture is strong enough to hold to the wood without it rubbing off.

**Chemical Stains.** These do not necessarily possess any particular colour. If they do, such colour may have no special purpose in the process of staining, the actual colouring of the wood being produced entirely by chemical action. Such materials as acetic acid, ammonia, lime, common soda, caustic soda, and vinegar, together with the salts of some of the metals, act chemically on certain woods and change their colour.

**Oil Stains.** With certain reservations, these stains can be used in conjunction with any desired kind of finish. The results obtained with oil stains are generally the best and most lasting. The oil, by virtue of its comparative slowness in drying, tends to penetrate more deeply into the grain of the wood, and so renders permanency to the colouring.

Pigments ground in oil are commonly used as stains when thinned with turpentine, but when using these it will be found that a certain amount of solid material may remain in suspension in the turpentine, and if so will lie on the surface of the wood like paint. It is, however, quite effective to apply the stain with a brush, keeping the solution well stirred, and when slightly dried, to wipe over with a piece of rag to remove any deposited material. Turpentine stains should not be used when a wax-polished finish is required, as the turpentine in the wood after staining is liable to soften the wax and produce defects such as spotting and local colour changes. Polish or varnish is, however, quite suitable for finishing. Other oil stains are used for special purposes, such as japan black, or asphaltum thinned with turpentine.

**Varnish Staining.** Varnish stains coloured by the addition of oil-ground pigments are used in cheap-grade work. The staining is rather confined to surface colouring, since the pores of the wood, which normally absorb the stain, rapidly become blocked with the heavy varnish. Hence the staining material cannot penetrate very deeply, and a surface effect suited to cheap work is quickly achieved. The varnish also produces a good body on which to work, and a final finish is possible by the usual polishing methods if desired. In other words, the processes of filling and staining are more or less combined in one operation. The colouring effect obtained with a varnish stain is by virtue of a thin semi-transparent coating on the surface of the wood, which is incapable of producing those contrasts in the grain which are possible with water or spirit stains, and rather tend to combine an inferior staining process with an equally inferior glazing or varnishing finish. Spirit stains are very common and can be obtained at almost any oil shop. Good-quality materials should, of course, be used.

**Wax Stains.** Hardwoods produce excellent effects when wax stained and finished with wax polishing. Such stains are made by mixing beeswax and turpentine, and colouring with oil-ground pigments. Wax stains should be applied when warm, either with a brush or rag, and should be allowed to harden off for a period of a day or two. A fine eggshell finish is obtained by rubbing rapidly with a piece of canvas or hessian, and finishing off with a piece of felt. An old felt hat comes in useful for such purposes.

**Aniline Dyes.** Data relating to these are given on page 50. These dyes can be purchased from a wood finishers' stores or from the chemist. They are not usually employed for imitating other woods but rather when self-colours are required, a good range of colours being procurable.

**Dyeing and Impregnation of Woods.** These processes, while producing similar results, are quite different in application, the former consisting of saturating the wood by soaking in dye solutions, while in the latter process the dye is impregnated under high pressure. The latter is effected after the sap in the tree logs has been expelled. The two processes are quite distinct from staining, which is more or less a surface effect, while the objects of the former processes are to colour the wood through its entire bulk. Dyeing is most suited to the treatment of veneers for decorative work, while the process of impregnation is confined mainly to the application of preservatives, the colouring being of secondary consideration. Timber for use in making floors, panelling, and structural work is often impregnated with preservatives for obvious reasons, while they act as colouring agents at the same time.

To ensure particular shades of colour coming true, only the whitewoods should be dyed, except in the case of black dye, which will take on almost any natural colour. The naturally brown woods are more difficult to dye to particular shades of colour, as the effect of the former is always doubtful.

To dye veneers these should be left immersed in water for from twelve to twenty-four hours to open up the pores and remove any of the sappy resinous material which may be left in them. After immersion the water should be drained off and the veneer placed in the dye, which will be readily absorbed. If the particular wood to be dyed is of a very resinous nature, it is common practice to boil it in a strong solution of caustic soda for a short time, after which it is allowed to soak in the cooling solution until the veneer is soft and pliable. At this stage the water should be drained off and the veneer dried under pressure to keep it flat. When dry, the white deposit, which is caustic soda, should be cleaned off and the veneer immersed in the dyeing tank. Dyes of various colours may be purchased which are in general made from vegetable sources, while aniline dyes may also be used. Generally a mordant is necessary to fix the colour, one of the metallic salts being used for the purpose.

**Water Coating.** This process is used only on cheap and inferior work, and consists of covering the surfaces with mixtures of the requisite shades of colour made by grinding dry colours in water. A binding agent such as size must be added to prevent the colour rubbing off when dry. Venetian red, ochre, burnt umber, and black are colours commonly used to represent mahogany, walnut, oak, and ebony. The solutions are best applied when warm so that the size is thin and well mixed. If the work is to be finished by varnishing, a good coating of size applied after the water coat has dried will be necessary before varnishing.

## STAINING

The application of stain to wood, while being similar to the application of paint, is much more difficult than the latter and requires far more practice to ensure success. Stain is usually applied with a brush as in painting, but because paint is a much slower-drying material than most stains, good results are much more difficult to attain in the latter case. It is the rapidity with which a stain dries off that renders the laying-on a much more difficult process than painting. It follows, therefore, that the less experienced worker or the amateur will find it easier to produce good work in the early stages of training by using stains of the slower-drying varieties. When some practice and experience have been gained with these, the successful application of the volatile stains will be more easily mastered.

The secret of success in staining is to produce perfectly even colouring without patchiness, the latter often being the result of trying to keep too many edges "alive" at the same time, and generally working without any proper method. An edge is said to be alive when it is wet, and if during the laying-on of the stain any edge of stain on an incompleted surface is allowed to dry, say for example while the brush is being recharged with stain, then the result will be unsatisfactory, inasmuch as the surface will not be evenly coloured. Method of procedure is therefore important, and a scheme of working must be decided upon before starting any job. When using the quick-drying stains the edges can only be kept alive by rapid brushwork, leaving as little time as possible between one brushful and the next. A word of advice is necessary, too, in connexion with corners of panels, and in ornamental work, mouldings, and quirks: an excess of stain is always liable to collect in these, resulting in dark patches. All corners and such places where stain *can* collect should therefore be well brushed out, and excess stain so removed.

**The Staining Shop and its Equipment.** It is important that the room in which staining is to be carried out should be free from dust, dirt, and dampness, and its mean temperature should be capable of being maintained as uniform as possible at about 65° F. Temperature is particularly important when dealing with spirit, varnish, and naphtha stains. If the room becomes too warm, then successful staining with these materials may be seriously impaired. Good lighting, both natural and artificial, is also an essential feature of the workshop.

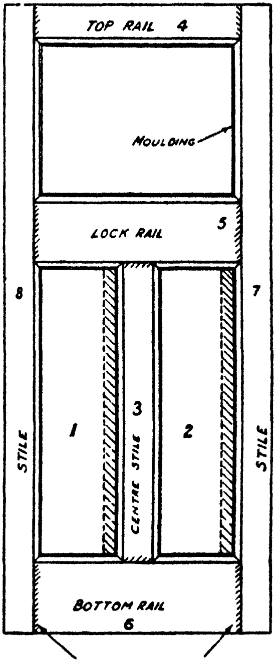
The equipment of the workshop is not particularly extensive, but for efficiency and good work it should be systematically arranged. Ample storage should be provided in the form of canisters and bottles in which to keep staining materials of all kinds. These should be carefully labelled and stored in places convenient to the workers, preferably in damp-proof cupboards or on shelves arranged round the shop. Another part of the room should be devoted to the storage of tools and accessories, while a gas stove or other heating apparatus is essential for boiling water and heating up materials for making stains and other requirements. A cabinet or cupboard for the storage of cotton wool, clean rags, sponges, and similar articles is a desirable piece of equipment.

With regard to tools, a stock of brushes forms the chief requirement. These should take the form of various sizes of flat brushes for dealing with large panels and flat surfaces, two or three sizes of fitches, some sash tools, lining pencils, and a stippler or two. White rags, cotton wool, some chamois leather, sponges, glass-paper, and some empty jam pots for mixing and holding stain, etc., complete the general list of equipment. The shop should when in working order present a clean and tidy appearance, everything being kept in a proper place and returned there after use so that work can be conducted on a systematic and orderly basis, while the need for cleanliness also cannot be overstressed.

In addition to the equipment already given, some odd pieces of wood of different varieties should always be at hand for testing colours, and no staining should be started until a test on a similar piece of wood has been carried out.

Some workers use colour charts to assist in mixing and matching colours, but the extended use of stains sold in standard colourings of a very wide range renders the colour chart less of a necessity.

**The Staining Process.** To illustrate the general procedure which should be adopted in staining, an example will now be given which it will be assumed is to be spirit or water stained. Fig. 2 shows a sliding door, the lower part of which consists of a double panel, while the upper portion is to be glazed. A door of this sort provides a good example to illustrate the general method of staining, being a common fitment in both cabinet and structural work. Further, it is an example often wrongly treated, particularly by the less-skilled worker.



CUT IN CAREFULLY UP TO ALL JOINTS AS INDICATED

FIG. 2. METHOD OF STAINING A DOOR

The correct procedure to adopt when staining a door is to begin with the panels and not with the framework, as is so often done. Referring to Fig. 2, a flat brush should be used, and the shaded portion of, say, panel No. 1 should be given a coat of stain. While the left-hand edge of this strip is still wet, a second strip similar to the first should be covered, taking care not to let the second strip of staining overlap the first. To even the colouring, press out the brush somewhat and brush the stain lightly *across* the grain, i.e. from right to left, and finally brush up and down *with* the grain. The work must not be allowed to dry during this finishing-off, which emphasizes the need for dexterity in the brushwork. Particular care is needed both at the top of the panel and at the bottom. In the former case the stain is apt to run away from the moulding, and leave the panel lighter near the moulding than the rest, while at the bottom the reverse effect is likely, due to the stain tending to collect in this region. To cope with these contingencies the brush should be carefully worked toward the mouldings in the direction of the grain, the brush being fairly well pressed out to get rid of an excess of stain beforehand. The laying-on in strips and the brushing of the stain should be continued until the panel is completed, great care being taken to ensure that no stain is allowed to encroach on the mouldings. For the first strips, e.g. on panels 1 and 2, and possibly the last strips, a narrower brush may be found more convenient than the wider one, which can be used for the rest of the panel. The second panel can now be stained, beginning with the shaded strip and proceeding as for the first panel. When complete, the centre stile should then be stained, after which proceed with the top rail, the lock rail, the bottom rail, and then the stiles, each in the order given and indicated by numbers on the diagram. Great care is needed in dealing with these latter parts. Firstly, care is required to cut in neatly at the joints shown by shading in Fig. 2. In no circumstances must any overlapping occur at these places; and secondly, when staining those parts in the proximity of the mouldings, great care is needed to avoid running over the latter, the stain being cut in neatly up to the edges of the mouldings. Finally, to complete the work, stain the mouldings carefully and avoid overlapping, using this time a flat fitch. If more than one coat of stain is needed for the door, similar procedure should be followed for each coat, two or three thin coats being in most cases better than one heavy one, which is always liable to turn out patchy. The question of the number of coats of stain required is important and should not be decided without some thought being given to the method of polishing to be employed. In this latter respect the colour of the stained work may be darkened by the polish. Further, it is common practice to work up the final colour by using stained polish during the bodying-in process, leaving the staining a little lighter than is finally desired. This procedure tends to produce a softer colouring, and when imitating the more expensive woods, if skilfully carried out, renders detection much more difficult.

**Matching End Grain.** End grain is naturally more absorbent than the other surfaces, and in consequence is always likely to come up darker in colour than the rest of the work. In dealing with this, the stain should be weakened by the addition of a little solvent, so reducing the colour density.

**Treatment of Large Flat Surfaces.** To stain a large flat surface such as the top of a table or sideboard is not easy if perfectly even colouring is desired. The process is particularly difficult if the work is attempted with a quick-drying stain, and may in fact easily ruin a first-class piece of woodwork. The best results will therefore be obtained with an oil stain, although this is risky if the final finish is to be by wax polishing. However, an oil-ground pigment in turpentine, which is a common form of oil stain, is quite satisfactory under a french-polished surface. To apply this staining material to a large surface it will be found effective to put on the stain with a large brush as rapidly and carefully as possible, and while the surface is still wet it should be wiped over with a wad of soft shavings, thus removing any surplus stain and regularizing the colouring. Alternatively to the soft shavings, a stippling brush can be used with effect, the action of which will be described later.

When dealing with a large flat surface on which water or spirit stain is to be used, the latter is more conveniently applied with a sponge. The use of the latter in preference to the brush avoids to a great extent the difficulty of keeping the edges alive while recharging the brush, which is a most important point with these volatile solutions. The sponge can hold a greater charge of staining material, and a larger surface can be covered with one charge. Care should be exercised in wiping off surplus stain, which must be accomplished before any of the surrounding surfaces have had time to dry.

**Stippling.** Large surfaces which are to be stained are commonly stippled, for which a special type of brush known as a stippler is used, and a description of this will be found in Chapter XIV. Stippling is used to ensure even colouring, and is particularly useful when the wood to be stained is not readily absorbent. In this case the stain will take longer to dry in, and if applied too liberally will run over the surface, producing unsatisfactory results. This tendency to run is checked by stippling, which consists of continually dabbing the wet surface with the stippling brush. Stippling is particularly recommended on large surfaces which are to be oil stained.

## STAINS AND DYES FOR PARTICULAR WOODS

Birch. This wood is commonly used for interior decoration, and is also fairly extensively used for furniture making. In the former case it is very often finished in its natural colour. The grain of the wood is fairly close but rises considerably when wetted, and it often requires a good deal of glass-papering down between the coats of stain. A fairly dry filler is therefore best, and when it is to be finished in its natural colour a tallow and plaster of Paris filler gives good results, after which it may be finished with button or white polish. Birch is also very suitable for imitating mahogany, and may be stained effectively with the standard spirit, water, or naphtha stains, the latter, being quick-drying, lessens the tendency for the grain to lift. Alternatively, a water stain may be made up using bismarck brown as a colouring agent, with a little brown or red pigment to tone down the colour if desired. Filling should be done after staining, using a suitably tinted tallow and plaster filler. The final polishing may be carried out with red polish or button polish. Burnt sienna ground in water is also a good stain for birch when mahogany is to be imitated, and may be toned with a little vandyke brown. Ground sienna may be purchased ready for use, but it will require thinning down with water, and a little glue size added will act as a binder and assist in filling. As a counterfeit for walnut, birch is occasionally used, when it is stained with vandyke brown water stain, being filled afterwards with a similar filler to that mentioned for mahogany but tinted to suit the walnut shade. Button polish may be used for finishing.

CANARY WHITEWOOD. This wood, commonly called American whitewood, is the easiest wood to stain satisfactorily, and is widely used for imitating mahogany and walnut and is occasionally used for ebonizing. As before, stains of standard colour may be purchased ready for use on this wood. A good mahogany stain may, however, be made by colouring orange polish with bismarck brown or sanders red, adjusting the quantities to give the required shade of colour and straining through a muslin strainer before use. About 2 oz. of orange lac per pint of methylated spirit is required, to which must be added the colouring pigments to suit. An oil stain may also be used consisting of raw linseed oil coloured with venetian red, to which should be added a little painters' driers. Spirit stains for walnut may be made on similar lines to those for mahogany, substituting vandyke brown as the colouring agent, while asphaltum dissolved in naphtha gives a quick-drying stain suitable for cheap work. This stain is not recommended for good-quality work.

MAHOGANY. This wood is finished in a variety of shades, of which the Chippendale and Sheraton finishes are among the best known. Chippendale, which is very dark, and the much lighter Sheraton colours may both be obtained by staining with a concentrated solution of bichromate of potash. This is made by dissolving potassium bichromate crystals in water, adding the crystals until they cease to dissolve, an indication that the solution is saturated. Bichromate of potash solution is in itself not entirely active as a stain, for when applied to the wood it merely colours it to a light shade of orange. When the work so coloured is exposed to bright natural light, however, it darkens, and by adjusting the exposure varying depths of colour may be obtained. The colour is fixed when of the required shade by giving the work a coat of raw linseed oil, which prevents further darkening. The colouring produced by this method is not fast, and ultimately bleaching takes place, particularly if exposed, as furniture may be, to strong light. Staining by this method is best carried out in daylight, and in no circumstances should the darkening be attempted by exposure to sunlight. The darker Chippendale colour can also be obtained by the use of a bichromate of potash solution with ammonia added, while the lighter Sheraton colour is effectively produced as described above, after which a coat of red oil effectively tones and enriches the colour. Baywood, which is a common substitute for the more expensive mahogany, may be treated by the same processes. Real mahogany can be stained by using liquid ammonia.

Another method of producing the dark Chippendale colour is by staining with French black stain, which can be purchased ready for use. This stain is commonly known as shoemakers' ink, and is made from nigrosine, gumless gall ink, powdered borax, and ground orange lac. About half an ounce of nigrosine is added to a pint of gall ink, the two being well mixed together, after which half an ounce of ground borax should be dissolved in half a pint of water and an ounce of ground orange lac added; the two mixtures are then combined. A strong solution of common soda and water applied at a fairly high temperature also produces a good darkening effect on mahogany. Fuming with ammonia is also effective.

OAK. This wood, which is being used so extensively at present, can be finished in a variety of ways, and a special chapter will be devoted to it.

PITCH PINE. This wood may be stained a variety of colours and can be made to produce excellent effects. If finished in its natural colour, either a plaster of Paris filler tinted with yellow ochre may be used or tallow and plaster, after which good results can be obtained by polishing with white or button polish. Other varieties of pine also stain well.

ROSEWOOD. This wood is now used in veneer form for decorative panels and is also made up on plywood backings for similar purposes. It is often imitated by colouring dark Italian walnut. Both real rosewood and Italian walnut may be coloured with red polish darkened with gas black. Oiling of the surfaces of rosewood must be done with as little oil as possible, as it tends to sweat rather more than most woods and in consequence the polishing is very easily ruined. The oil should therefore be thoroughly rubbed over with a dry cloth before polishing. Mahogany is often faked to represent rosewood, being stained with potassium bichromate and afterwards grained with a little red polish darkened with gas black, the latter being performed with a small brush or with the loose end of a rag. The grain of a piece of real rosewood should be carefully studied before attempting this operation. Venetian red darkened with gas black and mixed in raw linseed oil with driers makes an oil stain.

SATIN WALNUT. This wood may be finished in its natural colour, using button polish, previously filling with a tinted tallow plaster filler. Satin walnut also stains well to represent mahogany and walnut. Mahogany colouring is effected by staining with burnt sienna ground in water. This may be thinned down with warm water and a little glue size added to hold it. When dry, the surfaces may be given a coat of raw linseed oil and then finished off with button or red polish. To imitate walnut, vandyke brown mixed in water is a good stain, after which button polish may be used for finishing.

SATINWOOD. This beautiful wood may be finished in its natural colour with white polish, previously being filled with a tallow filler. If a darker shade is required, it may be obtained by staining with a weak solution of bichromate of potash. Alternatively, raw sienna ground in water or oil may be used, to which some driers should be added. Similar darkening may be effected on maple by using the same stains.

SYCAMORE. Sycamore is often coloured with self-colours and takes green, blue, red, and deep yellow staining very well, being white or nearly so in its natural state. Fairy dyes are commonly used, and should be applied fairly hot. This wood also finishes well in its natural colour if white polish is used. It can also be dyed a bluish grey colour with a solution made up of copper sulphate crystals dissolved in water or to a greenish colour by using iron sulphate crystals in water. The wood should first be boiled in a weak solution of potassium carbonate and water for a period of from three-quarters of an hour to one hour, about 1½–4 oz. of the salt being added to each gallon of water. After draining off, the wood should then be boiled in a weak solution of either copper or iron sulphate, about 6–10 oz. of crystals of either salt being added to a gallon of water, the quantity being adjusted to suit the depth of colour required. To this solution should be added a mordant, which may take the form of vinegar, about 1 part of the latter to 4 parts of the sulphate solution being required. In this solution the wood may be boiled for 1½–2 hours, according to the depth of colour required, being left in the solution until it is cold. The wood should be thoroughly drained and dried under pressure to keep it flat.

WALNUT. There are several varieties of walnut, including American, which is sometimes called black walnut, English, which is a rich brown colour, and Italian, which is a deep reddish black colour. Either of these may be finished in its natural colour, and when polished produce excellent effects. The black-streaked burr walnut used always in the form of veneers is oiled before polishing to bring out the figure. Modern plain walnut is commonly stained to a light fawn shade by mixing vandyke brown and whitening in water, afterwards filling in with a plaster filler tinted dark brown. A white polish finish gives a good effect. Walnut, which often requires matching, may be so treated with vandyke brown powder mixed in light button polish, which may be applied to the surfaces with a soft-hair brush.

WHITE DEAL. To stain white deal to a good brown colour a mixture of vandyke brown and ammonia may be used, to which should be added a small amount of warm glue size to hold the stain to the wood. Fairy dyes may also be used for staining this wood, and should be applied when hot. The familiar yellow colouring of white deal work, an abundance of which will be found in any hardware store, is obtained by staining with a solution of chrysoidine in water, adding some glue size to hold the stain to the wood and to act as a filler. The work is finished with a light spirit varnish. Chrysoidine is an orange-yellow colouring agent made by mixing 1 per cent of diazobenzene salt with a 10 per cent solution of meta-diamidabenzene. The resulting precipitate is dissolved in boiling water and cooled to 50° F., after which it is precipitated with ammonia and crystallized from a 30 per cent solution of alcohol and again from boiling water. It is this base from which acid salts are made, these being soluble in water and thus forming the familiar yellow stain. An aniline is also made by the action of tin and hydrochloric acid on the chrysoidine.

Vandyke brown and burnt sienna ground in water may be used on this wood to imitate walnut and mahogany respectively. These should be thinned down with warm water and some glue size added to hold the stain and act as a filler.

**Matching.** Reference to this part of the work will be made in Chapter V; nevertheless some remarks here seem appropriate, since it is the staining of the work which really needs correction. Uniformity of colour is commonly required, but due to the physical features of the wood irregular colouring is often apparent after staining, and this can be corrected either by a reducing agent in the case of the darker parts or by intensifying the colour of the lighter portions. Generally the easier method is to darken the lighter parts by an additional coat of stain, although this may not always be desirable. Dark portions of the work may, however, be reduced by an oxalic acid solution, using from 1 oz. to 2 oz. of the acid to a pint of water. The work to be reduced is then painted with the solution until the required colour is reached, after which the work so treated must be given a coat of vinegar to stay the action of the acid. Darkening is best effected by additional coats of stain, although nitric acid, lime, and ammonia can be used for this purpose. Considerable care is required in matching to prevent the work becoming patchy.

**Wiping Out.** This work demands a good deal of skill and provides ample scope for the application of artistic talent. It is a process confined mainly to use on painted carving and relief work, and consists of putting a stain on the top of a painted groundwork. While the stain is wet it is wiped out in parts so as to expose either wholly or partially the true colour of the groundwork. Both oil and water stains are used for this class of work, the wiping being effected by means of a piece of cotton fabric in the case of the former, and a piece of moistened chamois leather in respect to the latter. The rag or leather is twisted around the thumb of one hand, while the other hand is used to keep the wiper taut. It is, of course, necessary to change continuously the position of the thumb in the wiper so that only clean parts are used. By judiciously choosing the colours of the stains very pleasing effects may be produced, particularly if, in wiping, the colours are made gradually to shade off from one to the other. This type of work is commonly known as "scumbling."

Carving, which is usually confined to the better-class woods, is not often painted, but may be wiped by first staining it to a required colour and then wiping out as required. Artistic results of a similar nature to the foregoing may be obtained by using one stain over another of different colour. The application of stains in this manner is commonly called overglazing, and in particular such woods as pitch pine, having very contrasting grain, produce excellent effects when so treated. Generally a dark groundwork is overglazed with a stain of lighter hue, shades of yellow on green and red on green giving good effects.

**Ebonizing.** Owing to the high cost of real ebony, this wood is often imitated, a cheaper variety being ebonized by some suitable process. The counterfeit is invariably stained or dyed jet-black and finished to a semi-matt or eggshell gloss, details of the latter being given in a later chapter.

American whitewood ebonizes very well, but it has a much lower specific gravity. Better imitations are made by using mahogany or dark walnut, while oak is occasionally used. Ebony spirit and water stains can be purchased ready for use on any of these woods, but other stains are commonly used, such as for example French black stain. This latter can be applied to any wood considered suitable for imitating ebony, the wood being given a good coat so as to stain it a dense black. When thoroughly dry, the work should be well brushed with a stiffish bristle brush and given a light coat of linseed oil. One coat of black polish should then be given, after which the work should be filled with a tallow plaster filler blackened by the addition of gas black. The final polishing may be carried out with a black polish which will produce a lustrous finish. A semi-gloss or eggshell finish may be obtained by working down the polished surface with pumice powder by the method described in the chapter on French Polishing. Scratches should be avoided by working always in the direction of the grain. Black polish which is most suitable for this work may be purchased or can be easily made by adding gas black to white polish, straining the solution through a muslin strainer before use. Various other stains and dyes are occasionally used for ebonizing; they are, however, difficult to make, and in view of the fact that good stains are procurable ready for use it is hardly worth while attempting to make them. Such materials as bogwood, campeachy, indigo, verdigris, and vinegar are boiled with water and made into strong dyeing solutions. Black aniline dye can also be used, while spirit black thinned down with turpentine and japan gold-size makes a good quick-drying spirit stain.

Aniline dyes are extracted from coal tar and are obtainable in black, blue, green, orange, purple, red, violet, and yellow. These colours are not generally fast to light, and need fixing by a mordant. For bright colours the salts of tin and alumina are used as mordants, while for the darker colours oxide of iron is used. The mordant is put into the dyeing solution in small quantities before the wood is steeped in it.

# CHAPTER V

## FRENCH POLISHING

### FRENCH POLISH

THE term french polish is a comprehensive one applied to a very wide range of solutions used to produce similar finishes to different varieties of wood. There are some thirty or more kinds of french polish marketed, all of which are composed of the same or similar basic materials, namely shellac and spirit. A list of the principal varieties of polish is given in the Appendix, and an extensive list such as this is required firstly to meet particular colour requirements, and secondly to produce finishes of a particular nature such as that of a piano or floor, or when resistance to weather is an essential feature such as would be required for a shop front. The introduction of spray finishes, too, has called for a special type of free-flowing polish which must of necessity have a low viscosity. In the following paragraphs some recipes will be given for making up one or two of the commoner varieties of polish, although it is doubtful whether this practice is worth while in view of the extensive range of polishes now marketed. For special work and in special circumstances this may, however, be desirable.[1]

Shellac, or shell-lac, which is often listed merely as lac, is really a refined form of the resinous substance known as lac. This latter substance is a resinous encrustation created by the female parasitic insect *coccus lacca*, and is found on certain trees growing in south-eastern Asia. The twigs of the trees so encrusted are broken off, and after being immersed in water the lac breaks off easily into small pieces and is called seed lac. The unrefined lac is then tied up in long fabric bags which are gently heated until the lac melts, the molten lac being exuded from the bags by hand pressure and allowed to flow on to pieces of hardwood having smooth surfaces so as to form a thin layer. The layers when peeled and broken up into convenient-size pieces thus produce what is commonly known as shellac.

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[1] For further information refer to reports of the London Shellac Research Bureau.

Button lac is made in the same manner, except that it is pressed from the refining bags in intermittent drops which form, on the hardwood coolers, disks of shellac resembling buttons. Several shades of coloured shellac are obtainable such as button, garnet, orange, and white. The latter is made from the brown shades by a bleaching process, and is sold sometimes as bleached shellac. When any of these shellacs is put into methylated spirit it dissolves, and by adjusting the proportions of spirit and lac to a proper degree, french polish results. By the addition of other gums, polishes of different degrees of hardness and elasticity are produced, while the addition of certain gums gives to the polish an enhanced lustre.

To make a stock of the common brownish french polish, from 3 oz. to 6 oz. of broken flaked shellac should be dissolved in a pint of methylated spirit. If it is desired to colour the polish for reasons mentioned in the chapter on Staining, such colouring materials as sanders red may be added to the recipe just given; from 2 oz. to 4 oz. should be added, according to requirements. After well mixing the ingredients the solution should be strained through a muslin strainer, when it will be suitable for the treatment of the reddish woods such as mahogany, padouk, etc.

**Button Polish.** This polish is generally somewhat lighter in colour than ordinary french polish, and in consequence is better suited to the lighter-coloured woods of yellow shades, although not entirely confined to use on these woods. It can be made by crushing into small pieces about 4–6 oz. of button lac to 1 pint of methylated spirit, in which it should be dissolved, agitating the lac continuously while it is dissolving.

**Garnet Polish.** This type of polish, which is very nearly transparent, is made from garnet lac, and being almost transparent and a little darker than ordinary polish is useful on natural-coloured wood, improving the tones considerably. To make up this polish, from 4 oz. to 6 oz. of garnet lac is required to every pint of methylated spirit.

**Dark Polish.** This polish, as its name implies, is most suitable for the treatment of dark-coloured woods such as American walnut, Jacobean and the dark shades of oak, rosewood, and mahogany. It is made by mixing together orange, button, and garnet lacs in about equal proportions, adding from 4 oz. to 7 oz. of the mixture to a pint of methylated spirit.

**White Polish.** For very light woods and inlaid work this polish is commonly used. It preserves the natural tones of the wood and can be obtained in several grades. It is made by dissolving bleached or white lac in methylated spirit, about 5 oz. of lac to a pint of spirit being suitable proportions. This solution should be strained before use, and the white lac dried before mixing.

**Transparent Polish.** This polish is used on the lightest woods and is made from the same ingredients as white polish but is quite clear. Transparent polish contracts rather more than most polishes and therefore does not last so long unless other gums are added to make it more elastic. Bleached shellac mixed with methylated spirit, 3–4 oz. of the former to a pint of the latter being required. Careful straining is needed before use.

**Brush Polish.** Brush polish is used for bodying-in, a process to be explained later. It is applied with a soft-hair brush to surfaces which are to be french polished, and is cheaper than some of the french polishes. It is made by adding gums to certain grades of french polish.

**Coloured Polishes.** Most polishes except the white and transparent ones have a darkening effect, which must be allowed for when staining if matching or any particular shade of colour is required. On some occasions it may be desirable not to stain the work prior to polishing, but to use coloured polish which can be purchased all ready for use in certain shades. To colour french polish, dry pigments must not be added direct to the polish, and of course oil-ground pigments must never be used. Dry colours should be mixed with spirit and strained, the coloured spirit alone being added to the polish. The use of coloured polish often enriches colourings produced by staining, details of which are given in the chapter on Staining.

**Gums.** The addition of certain gums to polishes and varnishes produces hardness, lustre, and elasticity. If any gums are added to the recipes given for french polish for such purposes as those just related, then only small quantities, ranging from ¼ oz. to ½ oz. should be added, since they are fairly powerful. Such gums as benzoin are added to improve the lustre, while resin and gum copal produce hardness; the latter, which is not soluble in methylated spirit, should be dissolved in absolute alcohol. Much experience is needed to make full and beneficial use of these gums in making up polishes and varnishes.

The foregoing remarks relating to the manufacture of polishes have not been given with the intention of providing detailed information regarding their manufacture. The subject is too big to discuss fully in these chapters, and in fact is an important trade quite on its own, demanding a knowledge of chemistry in addition to a detailed knowledge of the requirements of the particular trades for which the manufacturer of polish and varnish caters. However, every worker, no matter what his craft, should have some fundamental knowledge of the materials with which he works, and it is from this latter point of view that the information has been given.

## THE POLISHING WORKSHOP AND ITS EQUIPMENT

Two of the most serious enemies of the french polisher are dampness and dust, either of which may prevent the production of first-class work. Two essential requirements of a polishing workshop are that it must be situated away from sources of dust and dirt so that the atmosphere may be as dust-free as possible, and it must be damp-proof. It must be roomy and well lighted both naturally and artificially, and arranged so that the mean temperature can be maintained at about 65° F., arrangements also being such that cold draughts and frost can be definitely excluded. Temperature is of particular importance in the polishing shop, partly on account of the gummy nature of the materials used, the viscosity of which is considerably affected by a small rise or fall of temperature, and partly because of its effect on the drying and hardening off of the polished surfaces.

Small pieces of work and such fitments as drawers require supports for holding them during polishing, and therefore some benches are required for this section of the work. The shop should be arranged so that work can be stood aside out of the way while it is hardening off, leaving plenty of room for other polishing work to proceed without encumbrance. Dust covers are an essential part of the equipment of the workshop and will be required to cover up work overnight, and also work which is standing by to harden off. The dust sheets are used to prevent dirt and dust particles, normally floating about in the atmosphere, accumulating on the polished or partially polished surfaces. Dust sheets also serve to reduce the risk of damage by scratching and bruising. A large cupboard or suitable shelving will be required for the storage of these dust covers, which should not be left lying about the workshop in a disorderly fashion. A good stock of ½-pint and pint bottles, jam pots, and a few air-tight canisters are essential. The bottles can be used for storing polishes, oils, spirits, etc., the jam pots for straining solutions, and the air-tight canisters or stoppered jars for the storage of plaster, pumice powder, litharge, shellac, and colouring materials. A good stock of soft white linen or cotton fabric will be required as well as cotton wool and pieces of plain fluffless felt such as that from which hats are sometimes made. In addition, some brushes will be required, such as soft-hair mops, pencils, and flat brushes, together with a stock of fine glass-papers.

The bottles, canisters and any boxes used for the storage of materials should be clearly labelled, and may be kept on shelves arranged round the workshop, while cotton wool, fabric, glass-paper, and the brushes are most conveniently kept in a cupboard or chest of drawers.

The amount of material required in stock and the size of the workshop are matters concerning the amount of work which is to be handled. Whatever the latter may be, plenty of room is essential and too much attention cannot be given to cleanliness, to which one of the chief attributes is tidiness, together with systematic working, which also goes a long way towards efficient production and good work.

## THE POLISHING RUBBER

The most important tool of the french polisher is his polishing rubber. So important is this implement that it has been considered desirable to devote a special section to its description, construction, and the method of using it. It is with this simple tool that the best french-polished work is produced, and to anyone who can appreciate this work it will not be surprising that it should be thought fit to give so much space and attention to its construction and use. It may be said quite definitely that the folding of the rubber cloth and the making of the pad are part of the polisher's craft, and much of the failure of beginners and amateurs is due to faulty rubbers and ignorance of their proper method of use.

The size of the rubber depends to some extent on the size of the work to be undertaken, larger rubbers being used for a wide expanse of surface and smaller ones for mouldings and

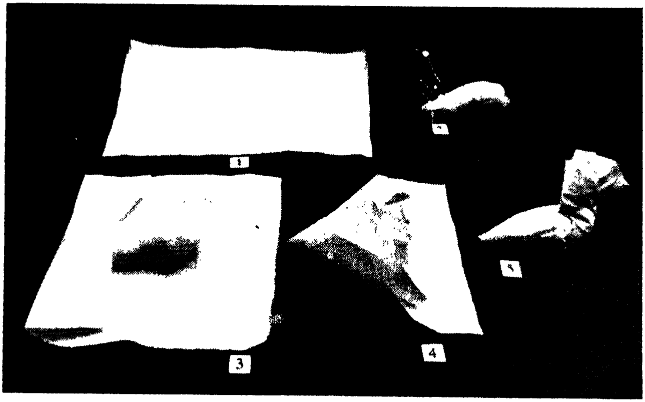

FIG. 3. THE CONSTRUCTION OF THE RUBBER

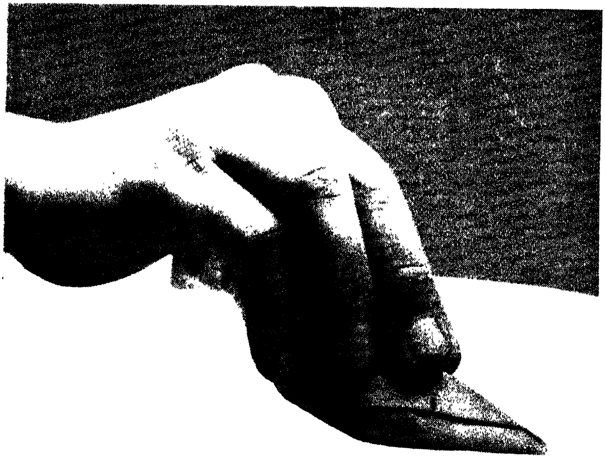

FIG. 5. HOLDING THE RUBBER

smaller work generally. The rubber consists of two parts only, namely a cover and pad or wad; the former, which is made of soft white linen or cotton fabric, covers the pad, which is made of cotton wool. The pad forms a sort of reservoir for the polish, supplying it to the cover, the function of which is to distribute the polish over the surface which is to be polished. The various stages in the construction of the rubber are illustrated in Fig. 3, each stage being numbered. The first illustration shows the cover, which consists of a piece of white linen or cotton fabric about 7 in. by 5 in., and the second illustration shows the pad, which is made in pear-shaped form from cotton wool. The largest diameter of this should be about 1¼–1½ in. and its length about 2½–3 in. This shape is conveniently formed by taking a piece of cotton wool and squeezing it in the hand to more or less the shape of a ball to form the larger part of the pad. Using a piece of sheet cotton wool somewhat similar in shape to the cover but smaller in size, and folding it similarly to that of the cover illustrated in stage 4, Fig. 3, a pad of the shape required will be easily formed. The material of the cover must be free from powder (commonly known as "dress"), and hence before being used for making a rubber the material should be well washed out in clean water and dried. The cotton wool for the pad too must be free from any powder, and good materials only should be used for making rubbers. The pad may require a little damping with polish to make it retain its shape during the rolling-up between the hands, and when completed it should then be placed on the cover as shown in the third illustration, about 2½ in. of the cover being folded over the pad as shown. The two corners of the cover nearest the toe of the pad are then folded over so that the edges of it and the two corners referred to meet along the centre line of the rubber as shown in the fourth illustration. By gathering up the remaining two corners and twisting the material overhanging the pad, the rubber is completed and is shown in the fifth illustration. A study of the pictures in Fig. 3 and some practice will enable the worker to produce a well-shaped tool, and in no circumstances must it be allowed to develop into a ball during use. A rubber consisting of a piece of rag in which some cotton wool has been screwed up to any odd shape is quite useless, and one cannot hope to produce good work with such a tool. The shape of the sole of the rubber which does the work is illustrated in Fig. 4, which was copied from one after it had had some use. The shape of the outline and the flatness of the sole should be noted: these are important features. It is essential that the covering of the sole should be free from folds or creases, as these are liable to cause ridging of the polish and lack of uniformity of the surfaces. The method of holding the rubber is shown in Fig. 5.

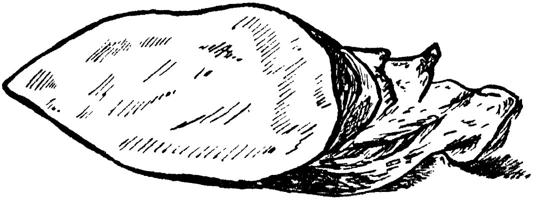

FIG. 4. THE SOLE OF THE RUBBER

**The Charging of the Rubber.** The rubber in no circumstances should be dipped into the polish. The polish is most conveniently contained in a small-necked bottle like a medicine bottle, the neck of which should be corked either with a spray top or cork in the side of which one or two grooves have been cut to allow the polish free egress from the bottle when it is inverted. The rubber is charged by *removing the cover* and shaking a little polish on to the pad, by means of the stoppered bottle, this procedure being adopted each time the rubber needs recharging. The cover is moistened all over by applying a little pressure to the sole by means of the thumb. When in use the normal pressure applied to the rubber keeps it sufficiently wet for the purpose for which it is intended. When not in use rubbers should be kept in a glass jar fitted with a screwed top into which a few drops of methylated spirit may be sprinkled to keep the rubbers moist. They must in no circumstances be left lying about on the benches, as in addition to picking up dirt they will harden and become useless.

## FRENCH POLISHING

We now come to the final stage in the process of wood finishing, namely french polishing, for which the processes described in the previous chapters are preliminary. It is safe to say that no other finishing process, at least for indoor work, is so effective or durable when well done, the beauty of the finish being too well known to need any comment. Unfortunately perhaps, from some points of view, at any rate, production methods have been introduced which are designed to give a pleasing appearance which can be produced with a minimum amount of labour, time, and therefore expense. Special polishes are used for this type of work, which although meeting present-day demands can hardly produce such durable results as the legitimate methods of french polishing.

French polishing is frequently regarded as a difficult process, in particular by amateurs, many of whom would like to finish their work themselves but are dubious about undertaking the job owing to risk of failure and the consequent damage to their woodwork. It is true that bad polishing can ruin good woodwork, for nothing looks worse than patchy and gummy polishing. Failure is, however, largely due to lack of patience and knowledge of the fundamental principles of the process. Furthermore, french polishing cannot be hurried if results of a high standard of durability and appearance are desired. Another important point often overlooked is the question of design. If a piece of work is to be finished by french polishing, then it should be designed so that as much as possible of the work can be assembled after polishing, for better results are always possible when pieces can be treated separately so as to avoid awkward corners, which always present some difficulty. It is a great advantage if mouldings can be screwed on so that they may be polished when out of their permanent positions, leaving panels and such-like free from obstructions, thus making the polishing of these much easier. In all high-class design work these points are carefully studied from the point of view of the finishing of the work, and experience will soon convince one of their importance. Finally, while it is possible to produce a finish on work within a few hours, the best results are achieved when much more time is allowed, say up to a week or more. In any case time must be allowed between the various coats of polish to allow the previous coating time to dry, and the more time which can be allowed the better will be the result.

French polishing consists of three processes, namely bodying in, bodying up, and spiriting out. The first two processes named are not intended to produce the brilliance of finish associated with french polishing, but rather to build up a foundation on which the final lustre and perfect smoothness can be produced by the last stage, i.e. by spiriting out. It is this latter process only which can therefore be regarded as the polishing process.

**Surface Oiling.** It is common practice to give the surfaces to be polished a very light application of linseed oil to improve the appearance of the wood. The general effect is to darken the colouring somewhat, at the same time enriching the figure. Oil should be applied very sparingly, as an excess of it will almost certainly produce serious defects in the finally polished surfaces. Red oil is occasionally used for the reddish-coloured woods such as mahogany, padouk, and rosewood. This oil is made by steeping a colouring agent such as alkanet root in raw linseed oil; it can also be purchased ready-made. Stained work may also be oiled to improve its tone. After oiling, the work must be set aside to dry thoroughly, after which it should be glass-papered down with fine glass-paper.

**Bodying In.** Although the grain of the wood will have been filled before this stage is reached, it will be found that the wood is still absorbent, and one or two coats of polish applied at this stage will readily soak in. It is with the object of stopping this absorption that the bodying-in process is primarily used. The polish may be applied with a rubber of the type previously described, or a piece of coarser rag capable of holding a comparatively large quantity of polish may be used, for the rubber must not at this stage be worked in a dry state. If the rag is used it must be free from fluff and any form of powder.

The bodying-in process consists of one or two rather liberal applications of polish to fill the grain, followed by normal coats applied with a polishing rubber. During the laying on of the first coat or two, the rag or rubber may be dipped into the polish, which can be poured out into a shallow dish. This is the only time during which the rules given previously regarding the charging of the rubber may be violated. The rubber or rag must be kept fairly wet and worked *across* the grain, using light pressure only. In no circumstances should the surface of the work be rubbed continuously, as this only agitates the film of polish and causes it to collect in ridges, which is of course fatal. The work should be given one coat of polish across the grain, after which it should be left to dry for a few minutes before another coat is given. In no circumstances must one coat be applied before the previous one is dry. The type of grain will govern the number of coats required, but except in the case of the very open ones two or three such coats should be sufficient, after which the work must be set aside for at least two hours to harden; if a longer period can be allowed, so much the better. If upon examination the surface now indicates that absorption has ceased, a fact which will be indicated by the presence of a film of polish on the surface, then the rubber can be brought into use for the next stage of the bodying-in process. Before adding further coats of polish, however, the surface must be glass-papered down to remove any small lumps and irregularities, leaving the resultant surfaces quite smooth. The rubber must now be used to apply a coat of polish, charging it in the proper manner, and dusting off the surfaces to remove any dirt which may have been left behind as a result of glass-papering. The motion which should be given to the rubber is important, and while the extent of the surface to be covered governs somewhat the actual motion possible, it should be on the lines indicated in Fig. 6. A coat of polish should thus be applied, using the rubber on the lines indicated and keeping it fairly wet. In no circumstances must it be used in a dry condition, neither must it be excessively wet. After being allowed time to dry, another coat may be applied in the same way, working carefully with a circular motion and light pressure only on the rubber. The work should now be left to harden off, and a much longer period is necessary, from twelve to twenty-four hours being required. The more time that can be allowed between the successive stages the better, for it is hardly likely that the

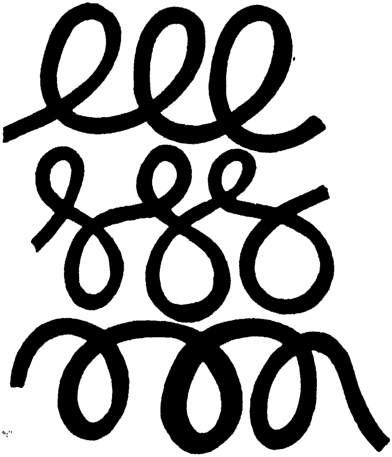

FIG. 6. TYPICAL MOVEMENTS OF POLISHING RUBBER

surfaces can become too hard, and the harder they are within reason the less will be the risk of the film of polish picking up when the next coat is applied. After these two latter applications of polish have hardened the surfaces should in general be continuous and free from patches, indicating that the grain has been completely filled. If such is not the case, additional coats of polish must be given on the lines indicated.

Assuming that the grain is completely filled, the surfaces must now be glass-papered down with fine glass-paper, using this time a few drops of linseed oil on the surface of the abrasive to prevent the polish pulling up and to reduce the risk of scratching the surfaces. Very little pressure too must be applied to the glass-paper, otherwise damage to the surfaces may result. The work should now be closely inspected, and if any small holes exist these should be filled by rubbing a piece of beeswax into them, taking pains to clean off any surplus wax that may be adhering to the surfaces. The work is now ready for the next stage in the process of french polishing; but, before passing on, one or two points need special emphasis. In this and succeeding processes the more time that can be given to the work the better the quality and the more durable will be the results. A series of thin coatings applied at proper intervals are definitely better than one heavy coat. Secondly, when applying polish in the bodying-in process, the reciprocating motion of the rag or rubber, referred to in the early paragraphs, should be dispensed with as soon as possible, and the circular motion of the rubber adopted; this should be possible after the first few coats have been applied across the grain. Further, it should be clearly understood that in the process just described we are not polishing but merely preparing to, and the surfaces must not be over-rubbed, otherwise the foundation will be spoiled. No attempt should be made to produce a lustre or brilliant finish at this stage. It is due to violation of this important rule that many fail in this work.

Finally, do not work with rubbers the covers of which are worn through or creased; it is fatal to good work.

**Bodying Up.** The second stage in the process of french polishing is known as bodying up, and the degree of success finally achieved is largely dependent upon the standard of achievement in this stage of the work. As it is essential to allow a considerable lapse of time for hardening off the applications of polish forming the bodies, it is most convenient and economical both in time and material if arrangements can be made for a number of articles to be polished at the same time. While some pieces are hardening the others can be worked upon, so that it is obviously an advantage to arrange the work accordingly.

Having completed the bodying in of the work satisfactorily and allowed ample time for hardening off, the work should now be glass-papered down with fine glass-paper until a perfectly flat matt surface is obtained. Care is needed in this stage of the work to prevent the introduction of scratches, and therefore when using the glass-paper only very little pressure should be applied, after which the resulting dust should be carefully cleaned off with a soft cloth. The surface should then be given a light wipe over with linseed oil applied with a rag; but only very little oil must be used, otherwise serious defects may occur after the work has been finished.

The polishing rubber can now be brought into use again, and for this part of the work some polishers prefer an old rubber, or at least one that has previously been used for bodying in. If a new one is used, it must of course be properly shaped, and should be worked up to the form shown in Fig. 4. Having obtained a suitable rubber, it should be charged in the manner described previously, but in no circumstances must an excessive amount of polish be used, for from now onwards the coats of polish applied should be as thin as possible, the rubber being hardly more than moist when used for this process. The rubber, too, will require a little lubricant to make it work satisfactorily, and for this latter purpose a spot or two of raw linseed oil should be applied to the sole with the aid of the finger-tips. The use of this oil is intended purely as a lubricant, for in no other way does it help to produce the finally polished surface; as such it must be used very sparingly. Thus, with the rubber charged and lubricated a coat of polish should be given, working with the circular motion already described and illustrated in Fig. 6. The movement of the rubber must be rather slow, and care is needed both in the manner in which it is put down on the surface at the start and how it is lifted off on finishing. It must never be dropped anywhere on the surface, and on starting it should be carefully placed down at the starting-point and kept moving until it is finally glided off say at one corner when the surface has been covered; in no circumstances must the rubber be left standing on the work. Having applied one good coat of polish the work should be stood to one side for a few minutes to dry off, after which about two more coats of polish may be given in the manner just described, allowing time between each application for the previous one to set. It is hardly possible to state definitely how many coats of polish to apply to each body, but in no circumstances should the process be continued when it becomes apparent that the previous layers are picking up. The action of the methylated spirit is, of course, to dissolve the lac, and if the working of the surface is continued too long, the undercoats will be softened and then begin to pick up. Therefore, as soon as the rubber appears to be persistently dragging or clinging, the polishing of the surface must be stopped and the work put aside to dry. This time from twelve to twenty-four hours will be required—the longer the period which can be allowed the better will be the results—and while hardening it should be covered with a dust sheet. When the work has thus hardened off it must be lightly glass-papered down before another body is given to it. For this purpose fine glass-paper which has been used is best, since the cut must not be too powerful, otherwise scratching may occur. The bodying may now be continued as directed, ample time between the bodies being allowed, and each one must be lightly glass-papered down before applying the next. No very definite rules can be laid down in regard to the number of bodies required, as so much depends upon the condition of the wood, its texture, and general grain conditions, the harder and closer-grained varieties coming into condition much more readily than the softer and more open-grained varieties. Bodying should, however, be continued until a fairly level and consistent surface is secured, which although not brilliantly lustrous should be definitely shiny. In general, when the surface is viewed from a very wide angle it will have a somewhat wavy or irregular appearance, due largely to the presence of rubber marks; no attempt, however, should be made to get rid of these at this stage.

Some difficulties may be experienced during the bodying-up process, which can be overcome by a little practice and care. For example, when using the rubber to apply the first body it will soon begin to cling or drag, particularly if it is a new one. This may be due to one or more of three causes, namely, the rubber being too heavily charged with polish, too little polish on the rubber, and the need for additional lubricant. Some practice and experience are necessary to enable the worker to obtain a correct balance of working conditions most desirable. Too much polish causes the previous film to soften and become sticky, a condition which if not attended to at once may prove disastrous. If the rubber tends to cling or drag, a few spots of linseed oil may be all that is necessary; while a persistence of the trouble indicates incorrect charging of the rubber or too much rubbing. If the polish is too viscous, this will cause persistent clinging, a defect which can be corrected by thinning down with a little spirit. As a test to ascertain if the correct amount of lubricant is being used, the sole of the rubber should be examined. If this presents a shiny appearance, the indication is quite definitely that an excess of linseed oil is being used.

When the bodying is considered complete, the surface needs careful examination. If it appears at all lumpy or ridged, these conditions must now be rectified, and to do this the pounce bag, already described in a previous chapter, is brought into use. For this work an old rubber must be used; in fact one which is thoroughly blocked with polish is best, provided always of course that the sole is in good condition. Instead of charging it with polish, however, methylated spirit should be used, together with a little lubricant on the sole. A little pumice powder should now be scattered on the surface, using the pounce bag. The rubber charged with spirit should now be worked over the surface, the pumice powder acting as a weak abrasive to reduce the irregularities. In no circumstances must polish be used for this work, as it will cause the pumice powder to collect in heaps and ruin the work. Work on these lines should continue until a satisfactory surface condition is secured, using the pounce bag, spirit, and lubricant as required, after which the work must be set aside and covered up for twenty-four to forty-eight hours to ensure perfect hardening. It will then be ready for the next stage, which, unless any colour matching is required, is the final stage known as spiriting out. Should pieces of the work need matching, an intermediate process is necessary, which will be described before the final process of spiriting out.

**Colour Matching.** However carefully the timber may be selected for a particular piece of work of large proportions, it is unlikely that the colour will be uniform throughout. Even if the work is stained it may not necessarily come up uniform in colour; and although complete uniformity of colouring may not always be necessary, generally speaking some correction will be required. It is part of the polisher's craft to rectify these colour differences, and it calls for considerable skill and ability to detect and match the various shades of colour. Matching is usually performed with a brush, diluted polish into which colouring media are introduced being used as a corrective. A satisfactory solution for the purpose is obtained by adding a pint of methylated spirit to half a pint of polish. To colour this solution a small quantity of dry pigment of the required colour should be tied up in a piece of muslin and suspended for a time in the diluted polish, after which the coloured solution should be strained through a muslin strainer. For the brown shades of woods, bismarck brown and vandyke brown may be used with gas black to darken if required. The required shade of colour may be changed by keeping the bag containing the colouring material in the polish for varying lengths of time, according to the depth of colour required.

The coloured polish should be applied to the work with a soft-hair brush, which must not be too wet with polish, light coats producing best results, even if more than one is necessary. As soon as the colouring is complete and the work well hardened it must be very lightly glass-papered with the finest grade of abrasive, using only the very lightest pressure possible. The coloured coat of polish now requires fixing, and this is effected by giving it a light coating of transparent or white polish applied with a soft-hair brush similar to the one used for the colouring, after which the work must be set aside to harden for as long a period as possible. When well hardened, a further light glass-papering will be necessary, after which another body or two will be required. Colouring and matching will be treated more in detail in a later chapter.

**Spiriting Out.** We now come to the last stage in french polishing, which is commonly known as spiriting out, and it is this process which produces the brilliantly lustrous surface usually associated with a french-polish finish. The applications of polish during the bodying processes are intended to provide for durability, while the last stage consists of removing rubber marks and rendering to the surface the appropriate finish. The finishing process demands considerable skill, and it is therefore not surprising to find a variety of methods used, the commonest of which will be described in detail.

*Method I.* The most usual and general method is to prepare a special spiriting rubber, which is made exactly similar to that previously described and illustrated at the beginning of the chapter. The only difference lies in the fact that two or even three covers are necessary instead of the usual one. The pad should be soaked in methylated spirit and then pressed out almost dry, after which the covers may be put on. It is common practice to make these rubbers some hours before use and to bottle them in an air-tight bottle of the type referred to previously in connexion with the storage of rubbers; this practice brings the covers into condition by virtue of the saturated atmosphere within the bottle. The principle of the process consists of dissolving the thinnest possible layer off the last body and levelling it out, for which the smallest amount of spirit possible must be used. The sole of the rubber should just feel damp and no more, and failure to observe this important point is certain to ruin the work. The motion of the rubber should be initially the same as in the previous processes, the pressure applied to the rubber increasing slightly as the rubber tends to dry out. Finally, the rubber should be worked in the direction of the grain with a reciprocating movement and fairly quickly, continuing until the surface is free from rubber marks, smears, and other defects, and is sufficiently lustrous. Beginners are advised to practise the entire processes of french polishing from start to finish on odd pieces of wood before attempting any important piece of work, because no amount of reading from a book can supply the requisite skill and experience needed. The work in all its phases is definitely highly skilled.

*Method II.* Instead of using a spiriting rubber as in the first method, the rubber used for the last body in the bodying-up process is thinned down gradually with spirit, and the surface treated with this until all undesirable marks have been removed. The final polish is secured by burnishing, for which a soft fabric pad is required. This should be made by folding into a pad a fairly large piece of soft white linen or calico which has been previously washed out in water and dried. The pad is then *slightly* damped with spirit and used on the surface with a reciprocating motion as before, continuing until the required lustre is obtained.

*Method III.* This method is somewhat similar to the previous one. The rubber used for the last body is thinned down with spirit, the surface being worked on until smears, rubber marks, and irregularities have been removed. A new rubber is then prepared and charged with toppings. The latter is obtained by pouring off the fluid lying on the top of white polish which has been allowed to stand for some time. This solution lacks the body of the polish proper and may be used with the new rubber just referred to or the fabric pad described in the second method, the rubber or pad being worked in the direction of the grain. The fluid must be used sparingly without lubricant of any sort and with light pressure only on the tool. The results obtained by this method are by many considered superior to those by either of the previous methods.

*Method IV.* This method is an acid finish for which a weak solution of sulphuric acid (oil of vitriol) is used, which hardens the surface of the polish. When the work has been bodied up, the rubber should be worked out by thinning with spirit, after which the surfaces are completed with a 10 or 12 per cent solution of concentrated sulphuric acid in water. The work to be treated is sprinkled with Vienna chalk, which is brought to a thin paste by means of a piece of chamois leather dipped into the diluted acid. The movement of the leather should be similar to that of the rubber when bodying. The process should be continued until the acid dries out, leaving the powdered chalk on the work, which should then be dusted off. When preparing the acid solution the liquids should be well agitated, as the densities of the acid and water are different.

*Method V.* A method commonly used for piano cases and high-class work of a similar nature consists of finishing either by the acid process or spiriting out, after which filtered ox gall is rubbed over the surfaces with the aid of a soft fabric pad of the kind used in the other processes. The ox gall should be filtered through bone charcoal and finally through a chemical filter paper.

**Finishing Small Parts and Decorative Work.** Some pieces of work are often too small or too intricate to be spirited out, and hence some other method has to be adopted. Such pieces are commonly finished by glazing, which really means that they are spirit varnished, a special varnish being used called glaze, which when dry has a brilliant lustre. Glaze can be purchased ready for use from suppliers of french polishes, or can be made up by dissolving a small quantity of benzoin gum in methylated spirit, after which it must be strained through a muslin strainer. Some workers add the gum to transparent polish and thin down the mixture with spirit. Either a rubber or small sponge is used for applying the glaze, while very intricate detail is best treated with a soft-hair brush, but no brushmarks must, of course, be introduced. The glaze should be applied fairly freely to well-bodied surfaces, but it should not be allowed to run and collect in corners.

# CHAPTER VI

## FIXTURES AND SUPPORTS FOR POLISHING

A TREATISE on polishing would hardly be complete without reference to methods of supporting certain special pieces of work which have to be polished and which cannot be conveniently held in the hands, or for other reasons are best supported in some convenient manner. To facilitate production and enable good work to be produced, some pieces of work are most conveniently polished while being temporarily supported for the purpose, and it will often pay to give special attention to this aspect of the work. While elaborate means of support are not as a rule necessary, certain refinements may add to the general utility of the fixture and may even be regarded as necessary if sufficient work of the particular type is available.

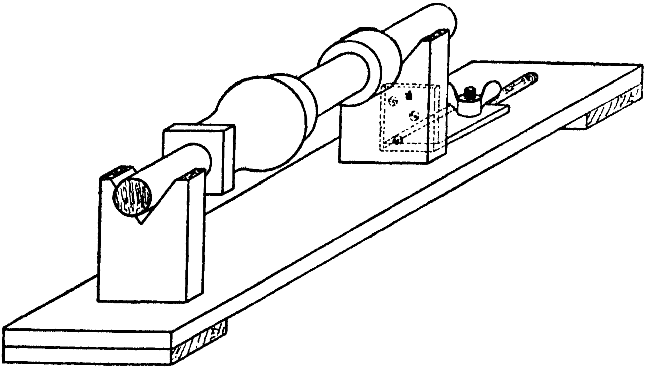

FIG. 7. ADJUSTABLE V-BLOCKS FOR SUPPORTING TURNED WORK

**Turned Fitments.** Among the most common examples of work which can best be treated in a fixture are small turned fitments which may be supported in two V-blocks as shown in Fig. 7. In this particular example, one of the supports is adjustable so that work of varying lengths may be supported, a refinement which, while not essential, adds to the utility of the fixture. Two sizes of supporting stands of the general design shown might be usefully employed, one made to accommodate a range of small work and the other for a range of larger pieces of work. Screws driven into the ends of the work for supporting it in the V-blocks are necessary when the ends are not suitably shaped for supporting or will not conveniently rotate in the brackets.

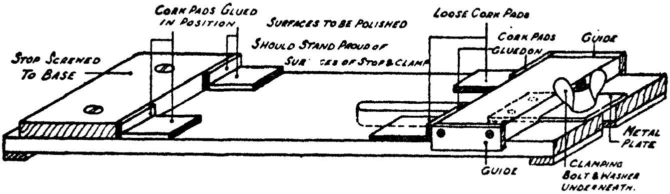
CORK PADS GLUED IN POSITION
SURFACES TO BE POLISHED SHOULD STAND PROUD OF SURFACES OF STOP & CLAMP
LOOSE CORK PADS
CORK PADS GLUED ON
GUIDE
STOP SCREWED TO BASE
METAL PLATE
GUIDE
CLAMPING BOLT & WASHER UNDERNEATH.

FIG. 8. ADJUSTABLE SUPPORT FOR POLISHING PANELS

**Panels.** Panels represent another type of work which can best be polished with the aid of some kind of supporting fixture, and Fig. 8 shows an example of the latter for this class of work. As in the previous example, refinement is introduced by making one support adjustable, which, although not essential, is certainly convenient for dealing with pieces of work of this type, the dimensions of which vary. A rougher method of support for panels consists of resting the panel to be polished on a baseboard, using short panel pins driven into the latter and near to the edges of the former to prevent movement. With this method there is a danger of damage to the edges of the work unless precautions are taken, and even then the risk of damage is not easily eliminated.

**Drawer Fronts.** Drawer fronts and boxes are also representative examples of work most conveniently polished by means of some temporary method of support such as is shown in Fig. 9, while small brackets and supporting pieces are best fixed to an odd piece of wood, as shown in Fig. 10. The piece of wood, which is cut so that it can be conveniently held in the hand, is screwed to an edge or surface of the work which will be unseen when it is finally fitted in position. By using a rack as shown in Fig. 11, a number of pieces of work may be polished simultaneously. If mouldings are to be fitted to panels or other work, these should be so arranged that they can be fitted in position after both the panel and the moulding have been polished separately. A little consideration of the requirements will enable a worker to arrange a support for polishing any such mouldings according to their particular size and shape. The unit construction referred to avoids having to polish in the inaccessible corners, a process which, if attempted, invariably results in unsightly collections of polish and smears

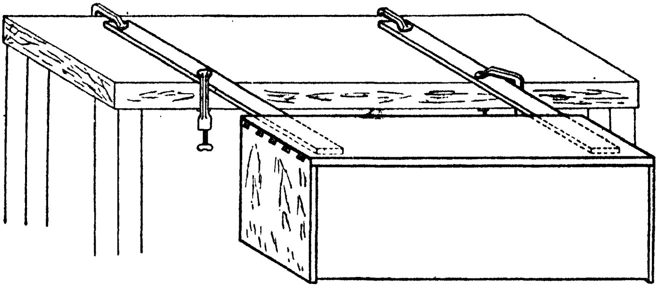

FIG. 9. SUPPORTS FOR POLISHING DRAWER FRONTS

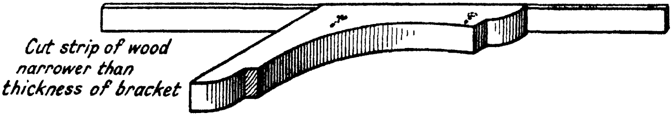

FIG. 10. BRACKET MOUNTED ON STRIP OF WOOD FOR POLISHING

due to the difficulty of proper rubber work. A good designer of woodwork will see that his construction is such that the mouldings can be put in after being polished, and in good work these are usually screwed in position from the back of the panel or to whatever they may be fitted. To facilitate the polishing of mouldings, these may be screwed temporarily or tacked to an odd piece of wood, the nails or screws being inserted from the back of the board and into a surface of the moulding which will not show when it is in position on the finished work. By adopting the type of construction referred to and also the given methods of polishing, the aggravating smeary and unsightly corners are obviated. When work is spray finished, the difficulties in regard to the corners are not, of course, experienced. Details of this process will, however, be given in a later chapter.

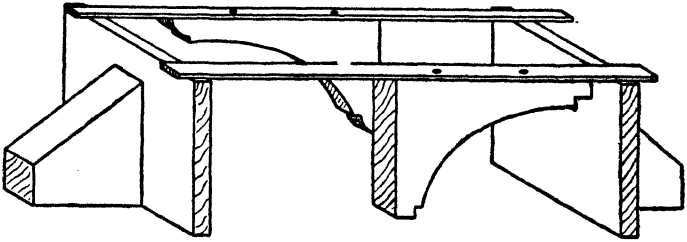

FIG. 11. DRYING RACK

A little thought along the lines indicated will enable a worker to devise supports for dealing with a variety of work, and any such methods which may assist in the production of good work and which may also save time should not be overlooked. Indeed, before a job of considerable dimensions is attempted, a method of procedure should be clearly decided upon and the necessary equipment for doing the work carefully prepared.

# CHAPTER VII

## TONING, MATCHING, AND REPOLISHING

ONE of the chief characteristics of french-polished work is the uniformity of colouring achieved, often accompanied by a richness of tone unsurpassed by any other finish. Typical examples are to be found in pianoforte work, wardrobes, and large panels. It is, of course, extremely difficult and, in fact, not a practical proposition with any degree of accuracy to match the various pieces of wood of which a cabinet is to be made in order to secure uniformity of colouring. This latter effect is generally produced by the french polisher, and the process is commonly called toning and matching.

Toning refers more precisely to the alteration of natural colours to required shades and is effected by the use of oils and dyeing materials. Matching may be more accurately described as a means of meeting the need for uniform colour. In addition to being able to tone and match work skilfully, a french polisher should be equally able to imitate grain and mottle his work effectively if requirements so demand.

None of the processes referred to above can be mastered by mere reading, and hard-and-fast rules cannot be given, much practice being required to achieve success. Needless to say, it is in this part of the work that artistic talent and a real eye for colour aid one immensely, and are in fact essential qualities of the really successful worker. Before attempting any of the processes detailed in the following paragraphs, the beginner should practise the methods described on spare pieces of wood, a quantity of which should always be at hand.

The colouring materials used should be very carefully selected, and in particular great care is needed when using painters' dry colours as colouring agents, since some of these materials tend to remain in suspension in the liquid and are therefore apt to lie on the surfaces of the wood in the form of paint, which is, of course, fatal. When these materials are used for colouring—in fact, in all cases—the dyed or coloured liquid should be well strained before use.

## TONING

Raw linseed oil is frequently used both for bringing up the figure of the dark brownish varieties of timber and generally improving the tone of both raw and stained wood. On the lighter-coloured woods, such as for example the white varieties of sycamore, oil has little or no beneficial effect on the general appearance. Spanish and Honduras mahogany are, however, enhanced to a marked degree by oiling, the figure being greatly improved, the colour darkened, and the tone considerably enriched. The darker shades of figured oak are also improved by oiling, while similar beneficial effects result by so treating dark walnut, rosewood, and timbers of a similar nature.

Generally the oil is applied after filling and staining if the latter is necessary, a piece of soft white linen or cotton fabric being used for the purpose. The oil should be applied sparingly, and well rubbed in, after which the work requires standing aside for a time to allow the oil thoroughly to harden off.

African baywood, which is a cheap substitute for real mahogany, is often dyed red, to resemble the latter more closely. Red oil is used for this purpose and also for producing the distinct red colouring often associated with polished mahogany. Red oil is merely raw linseed oil dyed by steeping alkanet root in it. It can be purchased ready for use from the usual sources or made as directed, allowing the alkanet root one or two days in the oil, after which the reddened liquid should be thoroughly strained and then bottled. The method of applying red oil is exactly similar to that given above for general oiling, but it should be noted here that red oil definitely stains the wood and as a stain is fairly strong in action.

As raw linseed oil is a rather slow-drying oil, many workers add to it a drier to shorten the time required for hardening off. For this latter purpose a more volatile liquid is needed, turpentine being frequently used. It is added in small quantities to the raw or red oil.

## MATCHING

Weak solutions of polish coloured with painters' dry colours are commonly stocked in the polishing shop for the purpose of matching up any work which may require such treatment. A good range of dry colours (see Appendix I) should be stocked so as to meet all likely requirements, together with any of the spirit dyes that the range of work covered by the shop is likely to demand. It is convenient to keep a stock of bottled coloured polishes for matching purposes. These solutions are most useful when made up as weak solutions, as too much colouring powder is likely to render them opaque and hence useless for the purposes for which they are intended. Matching solutions are best made up of about one part of polish to three or four parts of spirit, with colouring powder added to produce a pale solution of the desired colour. The general practice is to apply matching polish with a rubber or a soft-hair mop before the final polishing process is begun. The resultant colour of any work is, of course, influenced by the materials used in polishing, and hence it is very necessary when matching to make allowance for the effect on the colouring of the polishing materials. Considerable practice and skill is needed, therefore, in this work, and on no account should the matching be carried out as one definite operation, as due regard must be given to the possible effects of succeeding processes.

**Matching Up Light Portions of Work.** Although in all good-class work sapwood should not be used, it is very common for finishers to have to deal with wood of this type. Sapwood is that which is nearest to the bark of the tree, and is easily identified in most kinds of seasoned wood by its lighter colour and by the fact that it is generally softer than the wood nearer the heart. Because of the spongy nature of this part of the wood, the grain is apt to rise if it is made too wet during matching or otherwise, and hence to prevent this happening, a coat or two of polish applied with a rubber before matching will be found effective in meeting this contingency.

The colouring of small pieces of light sappy wood can best be accomplished with a wad of cotton wool. This should be dipped in weak polish, of the kind previously referred to for matching purposes, and then sprinkled with a little dry colouring powder of the requisite shade. Any excess of the latter must be carefully cleaned off the work before it is allowed to harden. A sufficient number of coats must, of course, be applied to give the required shade, and time allowed between the coats for hardening. Light glass-papering between the coats may also be necessary. Light parts of oak, for example, are effectively coloured by means of yellow ochre, which may be darkened, if necessary, with brown umber, while dark walnut requires vandyke brown or brown umber. Matching of the modern light-coloured walnut can be done with raw umber, well thinned down with spirit to make a dark putty colour. This shade is, however, more effectively produced by a bleaching process.

When matching up, the colours may be weakened by adding methylated spirit to the colouring matter, and before attempting any particular piece of work, it is always advisable to try out the colours on spare pieces of wood.

Large surfaces of wood which require matching can be effectively treated with the coloured polish referred to in earlier paragraphs, the solution being applied with a brush. If more than one coat is necessary, as very well may be the case, then time must be allowed between the applications for drying, and each coat must be lightly glass-papered down before the next coat is applied. Each separate coat, too, must be fixed, this being done by means of a light coat of polish applied after the coat of colour has been glass-papered. When completed, the work should be set aside to harden, ample time being allowed before the final polishing is begun.

**Bichromate of Potash.** Commonly referred to in trade circles as "chroma," bichromate of potash solutions are very useful for matching certain woods. Its use as a stain has already been referred to in the chapter on Staining, but in addition it serves as a very useful toning and matching material. It can, for example, be used for producing yellow shades of oak, while the darker brown shades can be effectively produced by applying two or more coats according to requirements. For matching up the darker varieties of mahogany "chroma" is also very useful; in addition, almost any of the dark brown varieties of wood can be effectively treated with this solution. Bichromate of potash solutions for matching are particularly useful, since the crystals of the salt dissolve in water or spirit, the resulting solution being quite clear. There is therefore no fear of the grain being obliterated, as may very likely occur when dry pigments are used, since these in general tend rather to hang in suspension in the liquid. A bichromate of potash solution suitable for matching purposes can be made by dissolving from 2 oz. to 3 oz. of the crystals in a pint of methylated spirit or water.

## GRAINING AND MOTTLING

The whole of the processes enumerated in this chapter require considerable skill and experience to enable good results to be obtained. Particularly is this the case in regard to graining and mottling, both processes, however, forming important parts of the finisher's craft. The movements of the hands are all-important in these two processes, while a good knowledge of the grain characteristics of the various varieties of wood will prove very beneficial in producing good results in this section of the work.

**Graining.** Graining is done by means of a rag, feather, or soft brush, and is a form of wiping out produced by a more or less oscillating movement of the hand which controls the rag or other implement. In addition to actual grain copying, some striking effects can be produced in the form of continuous waves by a suitable manipulation of the tool. For this latter purpose, a brush will be found most effective. Graining is carried out when the stain is wet, contrasts in colour to produce the necessary effects being obtained by wiping out the stain where required.

**Mottling.** Mottling is a kind of stippling process, a stiff bristle brush being used to produce the mottled effect. By varying the pressure on the stippler and also the length of time between the strokes, various effects can be produced. It is, of course, difficult, if not impossible, to describe how to obtain particular effects in either mottling or graining, and readers are therefore advised to try out these processes for themselves, as so much depends upon individual ability.

## REPOLISHING

The first thing to be done before repolishing can be attempted is to remove the old polish, either partly or entirely, which in either case is not always a particularly easy business. Because of this latter fact, cheap work is often repolished without the old being removed. The danger in polishing on top of existing polish is considerable, as the latter is liable to pick up under the influence of the spirit in the new polish, resulting in stringy and uneven surfaces. Scraping in any form is generally to be regarded as a dangerous method of removing old polish, although this method is sometimes resorted to. The danger lies, of course, in the risk of scratching the woodwork and also in dislodging the filling. Old methods of removing polish consist in principle of soaking the surfaces with methylated spirit or alcohol and glass-papering down while wet, finally wiping off with a piece of coarse fabric soaked in the spirit. When dry, the surfaces are finally papered down with fine glass-paper, after which they are generally ready for repolishing. Time can often be saved by glass-papering with a coarse paper, using linseed oil on the surfaces and removing only the upper layer of the old polish. The surfaces should then be prepared for repolishing by papering down again with a fine grade of glass-paper, after which a wipe over with a rag soaked in spirit is advised in order to remove the oil and the dust resulting from the glass-papering. These latter processes eliminate the necessity for working up a new body. Probably the best method of removing old polish is by means of one of the specially prepared removers which are now sold specially for the purpose. The best of these, such as "Perfecta Remover," are guaranteed, and are not only effective in removing the polish but reduce the amount of labour to a minimum. Many of these removers are petroleum mixtures, and are therefore dangerous to some extent, and hence come under Home Office regulation.

**Cleaning Preparatory to Repolishing.** Repolishing or touching up should never be attempted on work which is at all dirty. Any woodwork in time picks up a certain amount of dirt, particularly in the quirks and mouldings, where the ordinary cleaning methods are ineffective. Furniture polishing cream or paste, for example, is always liable to collect in such places, and thereby cause dirt to adhere, which in time accumulates, causing discoloration. In such circumstances no attempt should be made to polish over this, but washing should be resorted to: a solution of moderate strength consisting of common soda and tepid water is quite effective for this purpose, a stiffish bristle brush being used for applying the solution. On no account should the work be made excessively wet, particularly thin pieces, which may seriously warp under such treatment. After cleaning down with soda water, the whole of the work should be washed over with clean water to remove both dirt and soda. A word of advice is necessary here in respect to the action of soda on some varieties of wood. Oak, for example, is generally darkened by the action of soda water, and other varieties too are similarly affected.

**Cleaning Polished Work.** Work that has been well polished will always be improved in appearance by an occasional washing after it has been in use for a long time. If properly carried out, washing definitely improves the appearance of furniture and may even revive it to its former condition. Soft warm water to which some soap flakes have been added is best for the purpose, the work being washed over with a piece of soft sponge cloth or similar material. A clean piece of the material should then be washed out in clean warm water and squeezed out as dry as possible. On to this a very little furniture cream should then be sprinkled and worked over the surfaces of the furniture by the rag, using a third piece of rag for final polishing. Excellent results will be found to accrue from such treatment as this, particularly if the original polishing has been well done.

**Cleaning Off Old French Polish and Varnish.** Various substances, commonly in powder form and made up to patented formulae, are now marketed for removing old varnish and polish. These generally require diluting with water to make a solution of the requisite strength for each particular purpose. The action of removers of this kind consists in the first instance of destroying the content of the varnish or polish which provides them with power of adhesion. This is effected by one or more of the chemical contents of the cleaning material, while the water added to make up the solution serves to wash away the loosened varnish or polish. Lead acetate and lead soap are used in these removing compounds, to which water has to be added to give a solution of the required strength. Since many of these cleaning and removing substances are of an alkaline form, it is necessary after use to neutralize the work before repolishing or varnishing. Weak vinegar solutions are commonly used for this latter purpose.

**Sugar Soap.** Manger's sugar soap is a well-known remover and cleaning substance which can be used for a variety of purposes. For the removal of varnish and polish a solution made up of a carton of sugar soap and half a gallon of hot water is suitable. The solution should be applied with an old bristle or fibre brush, care being taken to see that splashes or runnings do not get into good work which is not to be revarnished or polished. Before revarnishing or polishing is attempted it is necessary to neutralize with a weak solution of vinegar and water. Exact details as to use are given on each carton, and the instructions cover a comprehensive range of uses. So far this substance has not been found very effective for removing cellulose.

## BLEACHING

**Hardwoods.** A good deal of modern woodwork, particularly in the furniture trades, is bleached before staining or polishing. Both oak and walnut are treated in this way prior to the final finishing. Oxalic acid is commonly used and is a fairly powerful bleaching agent, although not strong enough for all purposes. There are various strong bleaching agents on the market, some of which require the addition of ammonia. Generally speaking, bleaching agents are best applied with a grass brush, as bristles are destroyed by the acid. Liberal applications are necessary to the surfaces to be bleached, any excess of the liquid lying on the surfaces after about fifteen to twenty minutes being removed. While using bleaching solutions, it is advisable to wear rubber gloves to protect the skin. After bleaching, a period of not less than twenty-four hours should be allowed before staining or polishing. Oak is very often bleached to procure a very light colour. This can be done with a solution of oxalic acid, about 1 oz. to 2 oz. of the acid being required for each pint of hot water, the former being dissolved in the latter. The solution is very poisonous and should not be allowed to get on to the fingers or hands.

## CHAPTER VIII

### POLISHING LOUD-SPEAKER AND GRAMOPHONE FRONTS, INLAID WORK, TURNERY, ETC.

Many of the designs for loud-speaker and gramophone fronts and grand pianoforte music stands commonly embody fretwork. The latter is not, however, used to any extent nowadays for any other purposes. The polishing of fretwork is somewhat more difficult than the polishing of plain unbroken surfaces, and special treatment is required if first-class results such as one finds on pianos and musical instruments are required. The polishing of the frets also calls for patience and the expenditure of considerable time. To avoid warping, the quick-drying stains and fillers are best suited to this class of work, and reference to these in relation to fretwork has already been made in the appropriate chapters. The polishing of the broad surfaces may be carried out by the methods already given for general work except that a special type of rubber is desirable, the rubber which is used for general work being rather unsuitable. The sharp edges of the frets would soon cut the rag covering and tend to pull out the wadding, thus causing the latter to catch in the work and adhere to it. Generally a strip of undyed absorbent woollen material, about 1½–2 in. wide, is rolled up and stitched to form a cylindrical wad about 2 in. in diameter. This is covered with two or three thicknesses of linen rag, and the ends of the latter are gathered so that a rubber more or less the shape of a ball is obtained. The rubber is charged in a similar manner to the ordinary polishing rubber, and the broad flat surfaces are then conveniently polished by securing the work to a flat baseboard.

One of the greatest difficulties with which to contend in dealing with fretwork is the running of the polish over the edges of the frets. To avoid unsatisfactory results due to this inevitable happening, the edges of the work should be polished first, then the back, and lastly the front. Any polish which has run over the edges to the front can then be removed by light glass-papering. The procedure as regards bodying up and finishing is much the same as in general polishing work described in the previous chapter.

**Polishing the Edges of Frets.** Much of the cheaper fretwork is nowadays sprayed or varnished, and little attention is given to the finishing of the edges. However, in piano work, and if really good results are required, the edges of each of the frets should be properly polished. For this purpose a piece of wood of small section, chosen to suit the type of frets to be polished, is covered by a strip of linen rag. This is used as a rubber, and the edge of each fret is carefully polished with this implement, which is threaded through the frets and worked with a reciprocating movement, the rag being kept taut over the wood during the process. Excessive pressure on the tool should be avoided.

**Polishing Inlaid Work.** Data relating to the filling and staining of inlaid work have already been given in the appropriate chapters. It now remains to give some information relating to the final polishing of these special examples of work which require particular treatment. When dealing with inlaid work the kind of polish to be used will depend largely upon the varieties of wood of which the inlays are composed, rather than that of the surround. It must be clearly understood that button polish or any of the brown varieties of polish definitely darken the colour of the wood on which they are used, and hence, if an inlaid design contains white or any of the lighter-coloured woods, then only white or transparent polishes can be used if the whiteness of the wood is to be retained. Some of the transparent polishes slightly discolour whitewoods, and a careful selection of the polish to be used is therefore necessary. Natural colours of wood in the composition of the inlays or surrounds which require toning down or definitely altering can be done by giving those parts not requiring any such treatment a light coat of white polish and cutting in the remainder with a small camel-hair brush, using a stain of the requisite shade. Filling may be carried out as directed in the chapter devoted to that part of the work, while after the necessary preparation, the polishing can be done according to the instructions given in the chapter on Polishing. Generally, a transparent polish must be used for this class of work.

**Transfers.** This chapter would hardly be complete without some reference to the fixing and finishing of transfers. These are used for decorative work generally and as substitutes for inlays, while lettering is commonly affixed by this method. The successful fixing and finishing of transfers is a somewhat difficult job and should not be attempted on any important piece of work until after considerable practice and skill has been attained, otherwise disappointing results are inevitable. Transfers take the form of very thin films of natural or coloured wood secured generally to a piece of paper, the transfer, of course, having its back exposed while the face is fastened to the paper backing. Lettering and crests are often in gilt or gold leaf and are backed up in a similar fashion. The work to which the transfer is to be affixed should be finished off completely and allowed to harden thoroughly before attempting to fix a transfer: this latter point is particularly important if methylated spirit is used in the process of fixing a transfer to a french-polished surface. The region on which the transfer is to be fixed should be slightly roughened, which is best accomplished by using a little fine pumice powder on a rag. The transfer should then be prepared by cutting away the surrounding paper with a very sharp knife, and also any other paper which does not carry the actual design of the transfer proper. The result of this operation is therefore to leave the transfer in the form of a fretwork design, with any such paper adhering to it as is required to hold it together. As such it should then be dipped into methylated spirit, and after allowing the surplus liquid to drain off the transfer should be placed in position on the work and well pressed down with a soft rag. When satisfactorily fixed, the work should be left to dry, after which the paper backing to the transfer can be removed by wetting thoroughly with a sponge saturated with water, when it will be found to peel off. This latter operation must be carefully undertaken, first lifting one corner and then gradually raising the whole piece. Any wet gelatinous material adhering around the transfer should be cleaned off with a wet sponge, after which the transfer must be fixed. This is effected by applying a coat or two of white polish with a soft camel-hair brush, leaving time between the separate coats for each to dry thoroughly. When fixed, the work may be finished off by polishing, using the rubber in the usual way.

As an alternative to dipping the transfer in methylated spirit, some workers use a solution of gelatine and water, about an ounce of the former being dissolved in a quart of the latter. This is probably a safer method, particularly for the less experienced, since the action of the methylated spirit is to dissolve the polish on the work, and therefore special care is needed. It is claimed, however, that the transfer holds better when spirit is used and a better finish made possible.

**Fixing Lettering and Coloured Transfers under Oil-varnished Work.** The lettering and crests to be found on locomotives and carriages are fixed in position in a rather different manner from that described in the previous paragraphs. The letters (which used to be made in gold leaf) and multi-coloured crests are obtained on paper backings much the same as those already described, but they are not prepared by cutting out with a knife. Facsimile of the letters, for example, is drawn accurately on the work with a sable pencil, using gold-size. The dry transfer is then placed over the wet gold-size letter, the paper backing being peeled off when the size has had time to harden a little. When thoroughly hard, the rough edges formed by small bits of gold leaf (or whatever material the letters are made of) adhering irregularly are wiped off with a soft rag. Needless to say, the edges of the letters drawn with the gold-size must be cut clearly with the sable pencil, the same remarks applying to the fixing of crests and similar designs by the method of transfers. When the transfer is quite dry, the whole work may be varnished in the usual way.

**Polishing Turnery.** Tool handles and pieces of cylindrical work, although not essentially so, are conveniently polished in the lathe, while the preliminary preparation of the surfaces such as glass-papering can also be done by the same means. Care is, of course, needed in glass-papering, to avoid destroying the sharpness of edges and corners, which would spoil the design of the work. The polishing of turned work follows the general procedure already described, differing only in one or two minor details. The usual form of rubber, for example, is hardly suitable for reaching the intricacies of a more or less complex design, and hence, generally speaking, a more adaptable rubber is required. Many workers use the inside cotton-wool pad of an old rubber without the covering rag, the cotton wool conforming more to the exact shape of a piece of work when applied to it with pressure than would a rubber covered with its rag. An old wad is desirable, since being well charged with polish the wool is less liable to disintegrate and adhere to the work. The cotton wool, well charged with polish, should be pressed to the work while the lathe rotates *slowly*, the work having been previously filled according to the instructions given in the section of the work covering this operation. A good body should be worked up, glass-papering lightly between the successive coats of polish. The final spiriting out is best performed with a very soft piece of chamois leather damped with methylated spirit, the work during this process rotating at fairly high speed. Care is required in this operation to see that the work does not heat up excessively due to friction, otherwise the polishing will be definitely spoiled. Hardwood tool handles are usually filled direct with polish, no paste or other filling being used; the polishing of these is commonly performed with a wax gum polish in preference to the ordinary french polish, which is composed of lac and spirit. Tool-handle polish commonly consists of a thin, smooth paste made by dissolving beeswax in turpentine, the quantities being fixed to give a paste of correct consistency and in accordance with the amount of work in hand. A second solution composed of methylated spirit, gum sandarac, gum benzoin, and button lac is then prepared, using very *gentle* heat to dissolve the gums in the spirit. This latter solution should be well strained and precipitated into the wax turpentine solution, the whole being well stirred and thoroughly mixed. About 1½–2 oz. of each of the three gums is generally required to a pint of methylated spirit, while about 2 oz. of beeswax would be required for the given quantities of the gums.

Tool handles are also commonly polished in the lathe with oil, and this latter method of polishing will be detailed in a general way in a later chapter.

# CHAPTER IX

## OIL AND WAX FINISHES. FLOOR STAINING AND POLISHING

For certain classes of woodwork french polishing is not the most suitable finish. It is, for example, easily damaged by local heat, which causes the lac to melt, leaving a damaged surface which is not easily repaired; further, it is very liable, particularly under hard wear, to crack and blister. Spirit spilt on a french-polished surface will also cause damage. It is common, therefore, to find dining-table tops, the inside of the flaps of cocktail and spirit cabinets and shop counters, finished by a process commonly called oil polishing. Such finishes may be either true or partial.

### OIL POLISHING

This process, as its name implies, consists of working oil into the wood surface until further rubbing produces a lustrous surface. The process is extremely laborious, and takes a great deal of time if really first-class results are required. It is, nevertheless, a very refined finish and well repays the labour expended in working up the surface. The most suitable woods for treatment by this process are the hard brown woods, oak, mahogany, and walnut being examples to which this class of finish is usually confined. Generally speaking, the process is much easier than french polishing, and results can be very pleasing indeed, provided one has sufficient patience and energy for the work, which is necessarily prolonged.

**Materials for Oil Finishes.** For oil polishing, either raw or boiled linseed oil is used. There are two varieties of boiled oil, a light variety and a dark one, the latter producing a slight darkening effect which may or may not be desirable. Mahogany and similar red varieties of timber are sometimes oil polished with red oil, the manufacture of which has already been referred to. As linseed oil is slow-drying, something in the nature of a drier is usually added, which may take the form of American turpentine. The linseed oil should be heated somewhat but not allowed to boil, and about one-sixth to one-eighth of the volume of turpentine added to it, keeping the mixture well stirred during the precipitation. The oil must, of course, be removed from the heating stove while the turpentine is being added, as the latter is very inflammable. Other liquids such as naphtha are sometimes used, but for real oil finish no drier of any sort should be added to the linseed oil.

**Methods of Application.** The oil must first of all be thoroughly worked into the surface of the wood with a piece of soft linen fabric. The oil must be thoroughly rubbed into the surface by shortish strokes, backward and forward, while considerable pressure is applied to the rubber.

After well rubbing in one good coat of oil, the work should be covered with a dust sheet and set aside to dry. A similar coat should be applied every twelve hours or so until a surface of sufficient lustre and uniformity is secured. The final polish is obtained by constant rubbing with a soft cloth, using long sweeping strokes and plenty of pressure. Oil-finished surfaces will always be improved by constant and prolonged rubbing, and damaged surfaces are far more easily rectified than when french polish is used for the finishing. Large surfaces such as table tops, counters, etc., are conveniently and effectively polished in this way by means of a very heavy rubber consisting of a block of hardwood about 10 in. by 4 in. by 4 in. round which a piece of felt is wound and covered with a piece of linen fabric. In fact, any heavy core of approximately the dimensions given is suitable for a rubber, provided it is protected sufficiently to prevent damage to the surfaces to be polished.

In oil polishing, many applications of oil are generally needed, as the early ones will, of course, be absorbed by the wood. In fact, as many as thirty or forty coats may be required before a really first-class surface is obtained. An oil-polished surface should, when finished, present a fine eggshell gloss of very refined appearance and great durability.

**Partial Oil Finish.** The process referred to in the preceding paragraphs requires a good deal of labour and time, and is therefore often modified on that account. It will be noted that no actual bodying has been recommended except that produced by the continual oiling. It is in respect to the bodying part of the process that a modification is often introduced to save time and expense. In the partial oil finish, a body is formed by means of french polish, which can be worked up by the methods already given in the chapter on this part of the subject. Before finishing off, however, the lustre produced by the french polish must be reduced. This is done by means of a piece of felt and pumice powder, which is worked over the surface with the felt until the surface is dulled evenly and perfectly flat. Oil or water may be used with the pumice powder, and when a satisfactory surface has been obtained, the oil polishing may be commenced and continued until the desired result is attained. Numerous applications of oil will generally be needed if a really good wearing surface is required. Complete resistance to the effect of heat and the action of alcohol cannot be secured by this method of treatment, which for such requirements is not at any rate so good as the pure oil finish.

**Filling.** Surfaces to be oil finished may, if required, be filled by the methods given in the chapter on Filling. This is specially desirable if a partial oil finish is to be employed.

**Purposes for which Oil Finish is Specially Applicable.** The inside of the flaps of cocktail and spirit cabinets, small occasional tables for lounges, hotel counters, and dining-tables are most suitably polished by the oil process. If these are french polished, then heat and any spirit which may be spilled on them will cause the lac to soften and thereby damage the surfaces. Such damage is not easily repaired when the surfaces are french polished. An oil finish will, however, withstand the effect of heat, and hence hot glasses and spots of spirit do not damage the oil surface so readily.

Apart from oil finish for these special purposes, prepared french polish, such as table-top polish, can be obtained. Such polishes are claimed to be heat resisting and enable the required surface condition to be obtained more quickly and hence more cheaply than is the case with oil finish.

## WAX POLISHING

This type of finish, which is often applied to oak and mahogany, produces a result similar in effect to oil polishing, but less time is required to produce good results by this process. Wax polish produces a fine eggshell gloss and is most useful for finishing fumed-oak work, to which it imparts a very refined appearance. It is also used on reproduction furniture and panelling as well as on the genuine antiques. Real or imitation ebony is also best polished in this way, the results of wax polishing on this wood being superior to those produced by french polishing.

**Wax Polish.** A number of proprietary wax polishes are now obtainable, of which Ronuk is one of the best known. The basic materials from which these polishes are made consist of beeswax and turpentine. A good polish is easily made with these two substances, and either white or yellow beeswax can be used, according to one's particular preference. The wax should be cut into thin shavings and melted in the turpentine, sufficient of the latter being poured into an earthenware pot to cover the wax. Best American turpentine should be used in making wax polish, and not the cheap substitutes which are sold as turpentine. The wax will take several hours to melt in the cold turpentine, but by melting the wax first of all by gentle heat and then adding the turpentine, after removing the molten wax from the stove, a saving of time will be effected. The mixture must be well stirred while sufficient turpentine is added to produce the required consistency. When cold, a thin paste should result of a creamy white appearance. Care is needed when heating the wax and also when adding the turpentine, as both are highly inflammable. A deep pot standing in a saucepan full of water which can be heated is best for melting the wax, the turpentine being added after removing the pot a safe distance from the stove. The quantities of wax and turpentine required will depend to some extent upon the nature of the wood to be polished. For open-grained varieties a somewhat stiffer paste is required than is necessary for the more closely grained ones. Exact proportions cannot be given, but as a guide, ¼ lb. of beeswax and ½–1 pint of turpentine may be sufficient for general purposes. The paste is most suitable for general work when of the consistency of the thick variety of dairy cream. Beeswax is rather expensive, and hence substitutes are frequently used, paraffin wax being commonly employed as an inferior substitute. To harden the wax polish, small quantities of resin are often added, but best results in this class of work are obtained without its use.

**Method of Application.** A paste which is too stiff should be avoided for this work, as it is very liable to collect in corners and even on flat surfaces, and be very difficult to remove. A surface produced with a wax which is too stiff is very liable to be patchy and uneven. To apply the wax, a fluffless rag is best suited for the work, although a brush can be used quite effectively. Primarily, the chief point is to lay on the wax evenly, after which the success of the finish depends largely on the amount of rubbing given to the surface. A piece of coarse fabric is best for the initial stages of the polishing, which consists of rubbing the wax well into the surface in a similar manner as that described for oil polishing. When the grain appears to be well filled, a large brush may be used in preference to a soft rag for working up the surface. Finishing off is best done with a clean fluffless cloth, using long sweeping strokes. A fine surface with an eggshell gloss should result after continued rubbing, and by using a little wax from time to time such a surface can always be revived, provided all traces of dirt are removed before attempting any repolishing.

**Grain Filling.** Grain fillers are not generally used when the work has to be wax polished, the wax being sufficient to fill the grain effectively. Occasionally, however, a paste filler is used for special work where the grain is particularly open. As with oil polishing, if quick results are required a body is sometimes worked up with french polish which is subsequently dulled by pumice powder, after which the wax finish is applied. The true wax finish is, however, by far the best, and for certain work is second to none, being very refined and durable, imparting a quality to the work which makes it distinctive.

## FLOOR STAINING AND POLISHING

The staining and polishing of floor margins is commonly attempted by the amateur, and is not infrequently badly done. The chief reasons for poor results are the use of cheap and unsuitable materials, insufficient preparation of the surfaces, and incorrect methods of application. Most of the cheap materials marketed are varnish stains, which lie on the surfaces and therefore easily chip off in use, leaving the white wood exposed. A really first-class result is difficult to obtain with these materials, and even more difficult to maintain. Often the condition of the floor is not of the best, and difficulties are thus increased. The deal boards are too frequently covered with knots and rough places, which are not easily reduced unless properly handled, and unless a surface is primarily in good condition the finishing processes cannot be of a very high standard. The processes detailed in the following paragraphs are applicable to both the staining and polishing of domestic or other floor margins as well as the staining and polishing of complete floors such as those in ballrooms.

**General Conditions.** Many floor stains now marketed combine decorative, preservative, and hygienic properties and enable a good surface to be maintained with ease and a minimum amount of labour. Before attempting any staining, it is essential that the floor should be quite clean and dry, while care should be taken, if in the process of cleaning any soap has been used, to see that all traces are removed by thoroughly rinsing. Soda should not as a general rule be used for washing, as it acts chemically on some of the stains and changes the colour, producing perhaps very patchy results. Roughness and general unevenness of the floor must be corrected before staining, and this is best accomplished by the use of steel shavings, which are sold specially for the purpose. The essential primary point is, therefore, to see that the surfaces are quite clean and level. If such is the case, the foundation for a good result is well laid.

**Staining and Polishing.** Floors are conveniently stained in strips, three or four boards or rows of blocks being treated at one time, and as far as possible the staining tool should be worked only in the direction of the grain, not across it. Most floor stains are best applied with a wide, flat brush, but a pad of rag is sometimes used, particularly for the varieties of stain which require more rubbing into the wood to make them most effective. Most of the proprietary floor stains now available produce sufficient depth of colour with one coat, but should this not be so, then each coat must be allowed time to dry before another is applied. Light rubbing down with glass-paper may also be required between the coats, particularly if the stain is not one of the quick-drying varieties. There are on the market a number of floor varnishes which are supposed to stain the floor and leave a lustrous surface when dry. This type of material is responsible for much of the bad work which is so common in private houses, where attempts are often made by the uninitiated to make a carpet surround by staining the floorboards. Far better results can be achieved by staining first and then finishing by wax or oil polishing. The final polishing of a stained floor may be effected by one of four methods—wax polishing, oil polishing, oil varnishing, or french polishing. The first is very commonly used, while the last process is generally disregarded on account of cost and the liability of the finished surface to chip during hard wear. Oil polishing on floors is a laborious process, but the results obtainable are both attractive and durable.

Oil-polished surfaces can be washed with soap and water and polished afterwards with wax polish if desired. Ballroom floors are often wax polished, a beeswax and turpentine polish being used as previously described, or alternatively Ronuk may be used. Floors of this description are kept in condition by occasional polishing with powdered wax and a little french chalk.

A good finish on a floor margin may be obtained by oil varnishing after staining, a good-quality church oak varnish giving best results, since this material hardens well. Before varnishing, the stained surface should be lightly glass-papered. Varnished surfaces of this type can be kept in condition by occasional polishing with beeswax and turpentine paste or furniture cream.

**Floor Stains.** Walnut shades may be produced by thinning down burnt turkey umber ground in oil with turpentine and applying with a rag or brush, the depth of colour being regulated by the number of coats applied. Oak may be imitated by using raw sienna ground in oil and thinned out with turpentine, while mahogany effects are obtained by using Venetian red in oil. In fact, any of the red shades may be used according to taste. Oil-ground colours are best, as they do not raise the grain so much as water stains. Brunswick black thinned out with turpentine is sometimes used as a stain, the resulting surface being sufficiently lustrous to obviate further polishing. The action of this material is similar to that of a varnish stain, which clogs the pores of the wood, giving little or no depth of surface. Permanganate of potash dissolved in water is another stain used to imitate the brown shades of wood.

**Nail Holes.** It is important before staining a floor to see that all nails are knocked well down below the surface, and *after staining* the holes should be well filled. (Note that it is important to do the filling *after* staining.) For this purpose, putty coloured to match the stained work is most suitable, and it should be well pushed into the holes with the aid of a putty knife.

**Proprietary Stains for Floors, etc.** Certain ready-made stains are now marketed which combine decorative, preservative, and hygienic qualities. Many of these are sold for the purpose of floor staining and the covering of large surfaces generally. Colron is one of the best-known stains in this group, and is used extensively for floor staining. About 70–80 square yards can be covered per gallon of this stain, the quantity, of course, varying according to the condition and absorbent quality of the wood. About three hours should be allowed for drying, and the stain is available in twelve shades of colour, including self and natural colours. After the application of Colron, ample time should be allowed for drying, after which the surface must be well brushed with a weighted stiff bristle brush or with a dry, clean sack. Polishing is then effectively carried out by the use of a wax polish, which should be well rubbed into the surface of the wood. Special large brushes with long hinged handles are used for this purpose, so that lengthy sweeping strokes can be obtained, and hence a large area covered in a reasonable time. Polishing is carried out by placing a polishing cloth round the brush and polishing with a sweeping movement as before. Electrically-driven brushes are now available, together with all the hand polishing equipment. About a pound of wax polish is required for each ten square yards of surface to be polished, and after the wax has been rubbed in, about two or three hours should be allowed for it to harden before the actual polishing is commenced. Floor surfaces finished in this way can be maintained in clean and good condition by dry rubbing as described above, no washing being necessary. A little diluted wax polish may be used to revive the surface if necessary, but in general, nothing beyond dry polishing is required. The process just described is particularly useful for hospital, dance-hall, and schoolroom floors.

Presotim is another wood stain possessing similar qualities to those of Colron. Moreover, wood treated with this solution is regarded as free from attack by the death watch beetle, white ant, dry rot, and fungoid growth. It is useful for outside and inside work, and 35–80 square yards of rough wood can be covered per gallon, while a similar quantity will cover 100–200 square yards of smooth woodwork. Finishing may be effected by varnish or polish, an interval of about twenty-four hours being necessary after staining before the final polishing is attempted. A coat of knotting should be given to the stained work if it is to be finished with varnish. For the latter, a clear white knotting is most suitable. This material is obtainable in twenty colours and shades.

# CHAPTER X

## DRY SHINING, GLAZING, EGGSHELL GLOSSING, SPIRIT ENAMELLING

### DRY SHINING

THIS is the cheapest finish practised by french polishers, and is chiefly confined to interior finishes, such as the inside of drawers, wardrobes, and cupboards. Beyond this, dry shining as a complete finish is to be found only on the cheapest grades of work. The finish obtained by this method is crude compared to the true french-polish finish, but on the other hand, results are quickly and cheaply obtained, and for surfaces which are only occasionally in view, the grade of finish achieved is generally regarded as sufficiently good. Even if the finish is not of a very high standard, the french polish applied acts as a preservative and a protection for the wood. For dry shining no grain filling or bodying work whatever is attempted, and hence only a very thin covering of the wood exists when the work is finished. French polish is used for dry shining, applied with a polisher's rubber, the pores of the wood being blocked by liberal coatings of the polish. These are applied quickly with the object of providing a sufficiently good foundation on which to produce a polish. Excessive rubbing should not be attempted in this process, each coat of polish being applied by one stroke of the rubber with a small time interval between the coats to allow for drying. For the finishing process, a fairly wet rubber is needed which should be worked backward and forward in the direction of the grain, with as little pressure on the rubber as possible. No lubricant of any kind should be used on the rubber, and hence to prevent the polish picking up it is best to allow the polish applied by each stroke of the rubber to dry off before the next stroke over it is made. It will be observed that the polish is applied more as a varnish than as a polish, very little rubbing being actually applied. This being the case, results of a high standard by comparison should not be expected.

## GLAZING

The cost of good french polishing as described in detail in a previous chapter is both an expensive and a prolonged series of operations. Apart from the modern cellulose finishes, which produce quick results, true french polishing is often cheapened and the time of execution reduced by omitting the spiriting-out part of the process and substituting what is generally known as glazing. For this latter process, a special type of polish is required, made from gum benzoin in place of the lac which forms the basis of french polish. The results achieved by glazing, although effective to a certain degree, are not nearly so durable as when the work is properly spirited out, neither is the process recommended for such large surfaces as table tops, since it is difficult to obtain a perfectly even surface on the polish. Glazing is, however, a necessary operation on any work where the polishing rubber cannot be used, as for example in complex designs of moulding, carved work, and intricate pieces in general. Such work must be finished by glazing, but otherwise the process is confined to the cheaper grades of work.

**Glaze.** It is hardly likely that any worker nowadays is likely to want to make his own glaze, as it can be readily obtained from the finishers' stores. It can, however, be easily made by dissolving about 10–14 oz. of gum benzoin in a quart of methylated spirit, then allowing the solution to stand aside for a day or two after bottling before it is used.

**Application of Glaze.** A rubber similar to the type described for french polishing is suitable for glazing wide surfaces, but for intricate carvings and mouldings a brush is required. Before glazing is attempted, the work must be well bodied up (see Chapter V), after which glazing, which is the substitute for spiriting out, may begin. Glaze must be applied liberally, and hence the rubber must be used in a much wetter condition than it is for french polishing, the solution being applied rather as a paint, friction playing no part in the process as it does in spiriting out. The rubber is dipped into the glaze and lightly worked over the surfaces, moving the tool in the direction of the grain, applying one coat only and leaving ample time to dry before putting on another coat. A sufficient number of coats should be given until the required brilliance of finish is obtained. Carvings are generally treated with a mixture of french polish and glaze of about equal proportions, a brush being used instead of a rubber for applying the glaze solution.

**Glossing and Dulling.** An improved gloss may be secured on a glazed surface by a partial spiriting-out operation. When the glaze is hard, a spirit rubber may be lightly worked over the surface once or twice. Great care is needed in this operation and the rubber must not be too wet, otherwise the glaze will pull up and leave the surface in a worse condition than if no spiriting at all had been attempted. The spiriting, however, if done properly, will level up the surface and improve its general appearance, provided that it is not carried too far.

A dull matt surface can be obtained by adding about 4 oz. of sandarac to the given quantities of gum and spirit required for making glaze. To obtain a really good matt surface, however, the solution should be applied very sparingly, the rubber being but lightly charged. The process is similar to that described above for glazing so far as the method of working is concerned.

**Defects in Glazing.** The chief difficulties will be experienced when glazing wide surfaces, as in these cases the glaze tends to ridge, if applied with a rubber, and so produce a stringy surface. Defects of this character are corrected by a process known as swabbing, which in effect consists of dissolving the collected gum which forms the ridges. This is accomplished by applying methylated spirit with a swab made of a large piece of white cotton fabric folded to form a good pad. The swab or pad so made should be only moistened with spirit, and to prevent clinging, a little raw linseed oil may be used on the surface of the swab. The method of using the swab is similar to that adopted when spiriting out.

## EGGSHELL GLOSSING

The term eggshell gloss refers to a dullish matt finish as distinct from the highly lustrous one usually associated with french polishing. A brilliant surface is not always desirable, particularly in certain classes of cabinet work; in fact the beauty of a piece of work may be much enhanced by an eggshell finish. For example, antique furniture should almost in all cases be repolished to a matt finish, which is more in keeping with this class of work. Well-made wooden doors also are often matt finished, and when well done this finish has a surprisingly rich appearance which can hardly fail to appeal to the majority of people.

The process of dulling is effected after a good body has been applied and the surfaces worked up to a good lustrous finish. It is essential, after the polishing referred to is completed, that the work should be allowed ample time in which to harden off thoroughly before any attempt is made in the dulling process. The latter is effected by rubbing down with abrasive after a good french-polished finish has been made. For rubbing down, a piece of good hard felt is required, the variety used for felt hats being most suitable. The abrasive may take the form of pumice powder, rotten stone, or best of all fine carborundum powder as used by optical lens workers. This latter material, being harder and sharper, gives much more expeditious results, the former materials being slower in action.

As a lubricant, raw linseed oil is required in addition to the felt and cutting material. The dulling is carried out by rubbing down the surfaces with the aid of the felt on to which some oil and abrasive have been sprinkled. By applying a good pressure to the felt and working in the direction of the grain, a perfectly level and semi-gloss surface will result. When the required effect has been obtained, the surface should be well wiped over with a clean piece of rag and finally given a rub over with a piece of soft cloth moistened with benzoin.

To dull mouldings, and to get into corners and the intricacies of carved work, a brush is necessary, and is used in place of the felt. For this work an old sash tool is suitable for the larger and less complex pieces, while a smaller type of brush is needed for the more intricate parts. It is particularly important to work in the direction of the grain when two or more pieces of wood join one another so that the respective grains are in different directions, e.g. in the case of a door. Care is needed in all cases to ensure that the dulling of the surfaces is carried out evenly.

Tool handles and turned work can be matt finished by using a very fine cut glass-paper instead of abrasive powder. The surfaces may be worked up by spirit varnishing or french polishing and then dulled with the aid of the fine glass-paper and raw linseed oil. The glass-paper is best suited to this work when the cut has been reduced, either by rubbing two pieces together sharply, or by making use of paper which is partially worn out. Both for the polishing and dulling, the work may be rotated slowly in the lathe.

Carved work is often dull finished by using a stiff bristle brush and hard beeswax. The brush should be rubbed briskly on the wax and then applied to the carving, brushing continuously until the desired effect has been achieved.

## SPIRIT ENAMELLING

This process should not be mistaken for the common enamelling process in which oil-ground colours are applied to wood and metal by means of a brush. These enamels are quite unsuitable under a french-polish finish. In effect, the results obtained are similar, inasmuch as in both processes the grain is completely obliterated by the colour Spirit enamelling is a process used to enable wood to be french polished after it has been coloured to any desired shade, and for the purpose of colouring it is necessary to use colours dissolved in spirit. These dry off much more rapidly than do the oil enamels, and make a french-polish finish possible. Generally, the cheaper grades of wood are used for work intended to be finished by this process. After enamelling it is necessary to finish the work with a transparent polish which can be purchased ready for use.

A very good white spirit enamel can be made by dissolving 4 oz. of bleached shellac in a quart of methylated spirit to which 1 oz. of benzoin and 2 oz. of oil of juniper have been added. The mixture should be made up in an earthenware vessel which can be stood in a pot of warm water to assist in the dissolving of the ingredients, the whole being well stirred. When cold, the polish must be carefully poured off from the undissolved matter, and then a little flake white may be added, the whole being thoroughly well stirred before use. When applying the enamel, it is well to remember that several thin coats are far better than one heavy one, and consequently each coat should be applied as sparingly as possible with a soft-hair brush, and each coat allowed to harden off before another is applied. Glass-papering between the coats is essential and should be carefully done with a very fine cut paper partially worn. A sufficient number of coats should be applied to give the required density of surface. To harden off the enamel finally before polishing, a coat or two of transparent varnish to which some white enamel has been added should be applied, carefully rubbing down as required between the successive coats. Transparent varnish may be purchased ready for use or made by dissolving in a pint of spirit of turpentine, 8–10 oz. of yellow resin and 2 oz. of gum sandarac. When the work so treated is quite hard it may be finished off with french polish in the usual manner described in Chapter V.

If a filler is deemed advisable for work which is to be spirit enamelled, a very good one is clear paper varnish or a mixture of glue size and whitening. Two or three coats should be applied, each being well rubbed down before another is given, so that a perfectly flat surface results.

Coloured spirit enamels can, of course, be used under french polish. The white enamel already referred to can be tinted to various shades of the lighter colours. Dark colours can be obtained by tinting orange or brown polish with dry colours of the required shade. Some experience in colour mixing is required for this work, and a little practice at it is advised before embarking on a particular piece of work.

By laying one coat of colour on another and using the methods described in the section on Scumbling (pages 62–3), very artistic and interesting results can be achieved.

# CHAPTER XI

## VARNISHING

SINCE this book is concerned chiefly with finishes of a transparent nature, it would hardly be complete without some reference to varnishing. Although the processes and methods of application associated with french polishing are quite different from those used for varnishing, the latter has a very definite and special place in regard to wood finishing. Varnish in fact is used very largely as a preservative, and hence is commonly employed for work to be exposed to weather. Further, it is generally transparent, and thus can be used when the natural appearance of the wood is to be retained. It can be used as a matt finish, or alternatively a brilliancy may be obtained almost equal to that produced by french polishing, and at a much less cost. Apart from the dulling and flatting processes, varnishing is done by means of brushes and not by a rubber as in french polishing. It is, however, a highly skilled craft, and years ago the finishing of carriages, a class of work with which many readers may still be familiar, represented the highest grade of work within this category. The introduction of cellulose has, however, to a very great extent, displaced varnishing for these purposes.

Although varnishing as a process is much cheaper than french polishing, the materials from which varnish is made are very expensive. There are many grades of varnish (some not fit to bear the name) on the market at widely varying prices, and as a guide to the selection of a good varnish let it be clearly understood that the best ingredients required for good varnish are expensive and hence the manufacture of good varnish cheaply is impossible. Cheap varnishes do not give good service, and hence in the long run can hardly be regarded as cheap. Summing up the points mentioned, the conclusions to be drawn in respect to varnishing are briefly that, relative to french polishing, varnishing is cheaper, since the amount of labour involved is much less, and that it combines greater protective power against weather conditions with a brilliance of surface similar to that produced by french polishing, but with greater durability.

Varnish may be coloured and rendered either opaque or translucent. Such substances as gamboge, turmeric, or dragon's blood are used to produce yellow, brown, and red shades respectively, while black japan and Berlin black varnishes are commonly used.

## VARNISHES

There are in general three kinds of varnish, viz. oil, spirit, and water, each of these consisting of resinous substances dissolved in oil, spirit, or water. As distinct from the last two, which dry out by evaporation, oil varnish hardens by oxidization, the oxygen from the atmosphere combining with oil in the varnish which with the dissolved gums become hardened. Turpentine is sometimes added for thinning purposes, which in turn also acts as a drier. The best varnishes, however, do not contain very much of any of this substance, and hence dry out entirely by the process of oxidization, which is very slow, and thus good varnish cannot be expected to harden rapidly.

## OIL VARNISHES

Of these there are four principal groups, white, pale, medium, and dark, the former comprising Coburg, French, and marble varnishes. The pale varnishes consist of such varieties as pale carriage, pale copal, and maple, while the medium ones include carriage and oak varnish. The darker shades are generally termed hard oak and church oak. The uses of the first group are confined to high-class interior decorative work, the second to general interior work, while the latter two groups are manufactured for both inside and outside work. For such purposes as the varnishing of yachts special varnishes are made suitable for withstanding the effects of prolonged exposure to salt water and general weather conditions. These varnishes are called yacht varnishes and are obtainable in considerable variety. In general, oil varnishes are manufactured from a variety of resinous substances which are liquefied by the application of heat and to which are added hot linseed oil and a certain amount of turpentine. It is important to ascertain that a particular varnish is suitable for the use to which it is to be applied, since in general it is necessary, for example, to use a different variety for outside work from that for inside work.

## VARIETIES OF OIL VARNISHES AND THEIR USES

White Oil Varnish. This varnish is all but colourless and very pale, and is suitable for varnishing furniture and interior work.

Coburg and Extra-pale French Varnishes. These varnishes are the two palest oil varnishes made, and are used for the best kind of internal decoration.

Superfine Polishing Copal Varnish. This varnish is a pale variety and is used for interior work. It is particularly useful for varnishing over delicate shades of colour, and can be easily polished.

Carriage Copal, Elastic Copal, Oak, and Body Varnishes. This range of oil varnishes is most suitable for outside use, being specially manufactured for this purpose. For exposed work, where durability is an essential requirement, body varnish is most suitable, although one of the most expensive. It is used very largely for doors and frames. For outside work, varnish must necessarily be of an elastic nature so as to be capable of expanding and contracting without cracking as the temperature varies.

FLATTING OR RUBBING VARNISHES. Varnishes in this class are specially prepared so that individual coats may be rubbed down so as to secure a fine smooth finish when the last coat is applied. This type of varnish must dry out hard, and hence to achieve this quality a rather high proportion of resin is included in the manufacture. When small pieces of work are finished with this type of varnish, the rubbing down is often accomplished by the use of rotten stone and oil applied with the palm of the hand. Otherwise waterproof glass-paper is used, or a pad by means of which the oil and rotten stone are worked over the surfaces.

ENCAUSTIC OR FLAT VARNISH. This varnish, which contains a small proportion of wax, is used to produce a matt surface.

PAPER VARNISHES. Crystal varnish is a type of varnish for use on marble and other varieties of paper, although a fine-quality copal varnish is best suited to this work, since the former is not very durable. For special purposes such as for the preservation of oil paintings, where a perfectly clear varnish is essential, it is usual to employ a mastic varnish.

HEAT-RESISTING VARNISH. Such varnish can only be used within certain limits. No varnish can be regarded as heatproof, but for such things as baths and utensils which are required to withstand the effects of hot water a good varnish can readily be made up. The usual ingredients for this type of varnish are powdered litharge, linseed oil, powdered white lead, and a little red lead and amber. These materials are boiled up together.

VARNISH FOR WOODEN MUSICAL INSTRUMENTS. For finishing off violins, 'cellos, and similar instruments a varnish made up of coarsely powdered gum copal, alcohol, and a small amount of camphor is commonly used. To produce a golden colour, saffron and dragon's blood may be added to the above ingredients. Very striking results can be secured by carefully adjusting the quantities of these two latter colouring agents, and if properly done this should give the effect of gilding.

**Thinning Down Varnish.** Whenever possible, new varnish should be used, and when finished with it should be stored securely in a can with an airtight cork stopper. If for any reason old varnish must be used or if the varnish is found to be too thick to work, a very little linseed oil may be used as a thinner, together with a small quantity of best turpentine. The use of these substances is generally, however, to be deprecated, as the quality of the varnish may be adversely affected by their use, particularly if too much thinning is resorted to.

## VARNISHING

The foregoing remarks relating to the characteristics of the various varnishes manufactured should enable a choice of varnish to be made suitable for a particular type of work. While it is of primary importance to use the correct kind of material for a particular type of work, there are many other points which must be carefully studied in order that good results may be achieved, and these will be enumerated in the following paragraphs. It should be clearly understood that even if the correct kind of varnish has been selected for a particular job, unless the foundation for its application has been properly laid, results cannot be other than disappointing. Of paramount importance in respect to all work to be varnished is the need for perfect cleanliness, and all such work must be executed in a dust-free atmosphere.

To obtain the best results, it is of great importance to select the right time to do varnishing. Many craftsmen advocate that, provided the work is suitably protected, varnishing should be done on a wet day rather than on a fine warm one, since in the latter case dew and moisture are often deposited, whereas the rain maintains an atmosphere of fairly uniform temperature which thus prevents dew forming. Whatever may be the rights and wrongs of this argument, the fact remains that moisture on any surface which is to be varnished will produce undesirable results in the finished work. A common defect in varnishing known as "blooming" is due to the presence of moisture during varnishing. Blooming begins when the varnish is all but dry and presents itself as a milky film which persists when the varnish is quite hard. To avoid this defect arising it is as well to do varnish work early in the day, so that by evening, when moisture is likely to be deposited due to the fall in temperature, the varnish will be fairly dry. When varnishing inside work, it is essential that the temperature be maintained uniform from the time work is begun until the varnish is hard. Generally a constant temperature between 60° and 70° F. is most suitable. Draughts should be carefully avoided, as another cause of trouble is the effect of sudden chilling of the wet varnish.

Dust is another serious cause of inferior results, and while it is difficult to avoid a certain amount of dust in the atmosphere, every effort should be made to keep the atmosphere as dust-free as is possible. To keep dust down due to walking, a little damp sawdust sprinkled on the floor around the work helps to stop dust rising, while any crevices through which dust and draught may enter should be blocked up with waste paper. Clean floors and surroundings are, of course, conducive to a clean atmosphere, and hence this matter should receive constant attention. However, whatever precautions are taken to make a dust-free atmosphere, a certain amount of dust will always be found deposited on the work. The first operation, therefore, before any varnishing is attempted must be to dust off the work. Dusting brushes are stocked specially for this work, and it is not uncommon to find two such brushes in use at a time, particularly when light, delicately coloured work is in hand. One brush is kept for the initial dusting off and the other for a final dust over before varnishing.

These brushes should be kept clean by periodical washing in soapy water, after which they must be thoroughly well rinsed.

**Applying Varnish.** To apply varnish a sufficient quantity should be poured out into a suitable vessel, either of earthenware or glass, to complete the work in hand. The brush should not be immersed too deeply into varnish, and care should be taken to avoid unnecessary waste due to the picking up of too much on the tool. The varnish should be laid on by means of reciprocating strokes, first up and down and then at right angles to the initial movements. The finishing off should be performed by movements of the brush in one direction only. This final operation should be accomplished when the brush has been squeezed free of surplus varnish so that no more is added to the already completely covered surface. A warning is necessary here in regard to brushwork. Varnish, by its very nature, flows fairly freely, and hence levels itself out to a very great extent. It is therefore advisable to do as little brushing as possible, the amount being limited to that necessary to cover the work completely and evenly. In no circumstances should the brush be put to the work when it has become the least bit dry. As a general rule, the coats applied should be thin so that they harden well and reasonably quickly and also permit adequate glass-papering. On new wood, the first coat may be heavier than the succeeding ones, due to the fact that much of the primary coat will be absorbed. When varnishing mouldings and quirks, these should be inspected after about thirty or forty minutes, and any surplus varnish that has collected should be carefully wiped out with a small tool.

**Varnish Brushes.** The choice of brushes is all-important, as are also their treatment and maintenance. Details respecting these points will be found in Chapter XIV, which is specially devoted to this part of the subject.

**Varnishing New Wood.** The preliminary treatment of new wood depends largely on the number of coats of varnish which can be applied. If the cost of finishing is of little importance, then a sufficient number of coats can be given until a satisfactory surface results. The chief difficulty in the treatment of new wood is the liability of unequal absorption due to variation in the grain condition. Obviously, if only one or two coats of varnish are to be applied, then some means of stopping the unequal absorption must be adopted before any varnish is put on. Otherwise a uniform surface may not be readily obtained, the unequal absorption showing itself clearly by varying degrees of brilliance of surface, giving the work a patchy appearance. There are in practice one or two methods of dealing with this contingency, one of the most common methods being to apply to the raw wood a coat of glue size which has the effect of blocking up the pores of the wood and thus preventing further absorption. The size should be applied sparingly, particular care being taken to avoid the collection of it in corners and in mouldings where difficulty might be experienced in wiping out any excess of the glue size. Furthermore, too much size in the work may adversely affect the brilliance of the final varnishing.

Occasionally new wood is given a coat of varnish and is then sized with an isinglass size, after which varnishing is continued.

**Varnishing of Colours.** To preserve self-colours such as blue, green, black, or red, it is essential to use a very pale variety of varnish, and on no account should the darker or opaque varieties be used in such circumstances, as the colours will in all probability be spoiled. Mixed colours or the medium ones can, however, be treated with the darker varnishes without serious detrimental effects.

**Treatment of Rolling Stock and Similarly Exposed Work.** While much of this work is now finished by means of the spray gun, it may be worth while to mention here the method by which the brilliant finishes associated with this class of work have been achieved. The larger surfaces are usually bodied up with french polish and then finally varnished, a pale carriage varnish being used for the purpose. Generally speaking, french polish is unsuitable by itself, being insufficiently durable to meet extreme weather conditions. Shop fronts and other similarly exposed woodwork are often treated in this way, the finish being more durable and retaining its good appearance longer than if french polish alone is employed.

**Floor Margins.** The processes detailed in the following paragraphs must not be confused with spirit varnishing. The majority, if not all, of the familiar floor varnishes sold at the local oil shop are spirit varnishes, while the intention here is to deal with oil varnishing only. Methods of staining and finishing floor margins generally have been given in Chapter IX, but yet another method is sometimes employed in which varnishing is resorted to. Here again it should be mentioned that really good results can only be obtained if sufficient time and energy are expended on the initial preparation of the wood surfaces. All too frequently the deal boards used for flooring are too rough to be varnished without considerable preparation. The methods of doing this preliminary work are given in Chapter IX, in which floor staining is detailed.

Assuming, therefore, that the surfaces are smooth enough to begin work, then the first step is to size the portion of the floor to be varnished. A glue size is suitable for this purpose, and it should be applied sparingly with a brush. If any roughness results when the size is thoroughly hard, light glasspapering with a fine cut paper should be given, after which any resulting dust must be entirely removed. Staining is the next step, and a suitable oil varnish stain can be made by mixing thoroughly the required colouring pigment with approximately equal proportions of varnish, turpentine, and linseed oil. Ordinary painter's colouring pigments can be used to obtain the desired colour. If the floor is in a properly prepared condition, one coat of this varnish stain should be sufficient. When this is thoroughly hard, which may mean the lapse of a day or even two days, the nail holes should be filled with putty coloured to match the staining. When quite hard the whole surfaces should be lightly glass-papered down and the dust removed, either with a soft rag or better still by means of a damp chamois leather. The surfaces may now be varnished, and a hard oak varnish is recommended for such work. The varnish should be applied fairly liberally, and well worked on the surface in both directions of the grain. For more durable results, two or more coats of varnish should be given, a light rubbing down of each coat with glass-paper being necessary before adding another. The time required for each coat to dry depends much upon the atmosphere conditions prevailing, but it is essential that each coat be given ample time to harden thoroughly.

**Varnishing Paintwork.** In order to secure first-class results on painted work which is to be varnished, the final coat of paint must be "flat," or in other words free from gloss. To achieve this result, the paint for the final coat should be mixed almost entirely with turpentine, since gloss is imparted to paint by linseed oil, which for the purpose under discussion should be almost entirely eliminated. Further, the last coat of paint should not contain any drier, as most of those used produce defects in varnishing, and if turpentine is used no drier should be needed. Detrimental effects are also produced in varnish when such materials as barytes, red lead, whitening, and vandyke brown are used in the paint. Therefore, for best results, these materials should be avoided in any paintwork which is ultimately to be varnished. If used for washing down, soda must always be thoroughly rinsed off, as must soap also, as household soap usually contains a proportion of soda. If this is not done, serious defects are likely to occur.

**Graining.** There are at least two methods of graining, one known as oil graining and the other as water graining. Varnishing may begin on the latter as soon as the water has dried out, but in the former it is necessary to wait some four or five days before varnishing is attempted, owing to the fact that it is necessary for the oil to dry out completely, otherwise the varnish will be unsatisfactory.

**Rubbing or Felting Down.** In first-class work where a number of varnish coats are to be applied it is customary to rub down each individual coat when hard before applying another. Commonly pumice powder is used, while fine carborundum powder is more suitable for the harder varnishes. The finest varieties used by optical glass workers are suitable for this work, their greater cutting power giving more expeditious results. Usually water is used with these abrasives as a lubricant, the rubbing being done by means of a stiff bristle brush, a piece of felt, or a felt pad sold specially for the purpose. Rubbing should be continued until the surface is perfectly even and completely dulled. The motion of the rubber should be more or less circular, similar to that explained in Chapter V.

**Grading Emery Powder.** The best qualities of carborundum powder are generally accurately graded, that is to say they contain no large lumps of hard material such as are commonly found in emery powder. It will at once be appreciated that the presence of such lumps may produce very serious damage to a surface if picked up on the rubber, and hence when about to use emery powder it is as well to grade it beforehand. The general method of doing this is to stir a quantity of the emery powder into a large basinful of water and then allow it to stand for a short time. The large lumps of foreign matter will then sink, leaving the finer powder in suspension in the water. This water may therefore be carefully poured off into another basin, when after a time the particles of emery powder which have been in suspension will sink, leaving the water clear.

The "sediment" thus produced is then ready to use as a fine abrasive.

**Removal of Grease and Oil.** All traces of grease and oil should be removed from a surface before varnishing is attempted. This can be conveniently done with the aid of a rag soaked in benzoline. The latter, being very volatile, will soon evaporate, leaving a dry clean surface.

## SPIRIT VARNISHING

Spirit varnish, as the name implies, is composed of gums dissolved in spirit instead of oil. It is quick-drying, and is therefore not very suitable for the varnishing of large surfaces, while the fact that it does not flow like oil varnish makes spirit varnishing a more difficult process than oil varnishing. Considerable quantities of spirit varnish are sold for floor varnish staining and work of a domestic character, often undertaken by the amateur.

**Methods of Application.** It is necessary to start varnishing on a good foundation, and therefore all surfaces must be well glass-papered down perfectly level, after which the grain should be filled to prevent unequal absorption. It is a mistake to use thick spirit varnish with the object of avoiding grain filling, a practice which is very common. A good filler consists of diluted french polish or spirit varnish, about equal parts of either of the former and methylated spirit being well mixed together. Glue size is sometimes used for filling, as it is cheaper; it is, however, apt to raise the grain, which necessitates further glass-papering.

A common method of applying spirit varnish is by means of a brush, but for really good results the brushwork must be supplemented by the polisher's rubber, since spirit varnish does not flow like oil varnish and easily forms ridges: it is to reduce the latter that the rubber is used. Each coat of spirit varnish applied, when hard, should be carefully rubbed down with fine glass-paper, or alternatively each coat may be levelled with the aid of the polishing rubber. If coat after coat of spirit varnish is applied without proper levelling, then the result is almost certain to be unsatisfactory, due to the varnish piling up in ridges. This latter defect is often corrected by rubbing the work down with a little methylated spirit or naphtha applied with a pad of cotton wool.

A common defect to be found in spirit-varnished work is cracking, due generally to the too liberal use of the varnish. The latter, which should be applied with a camel-hair brush, must be put on in thin coats, the brush being worked in the direction of the grain of the wood wherever possible. The methods used for staining and detailed in Chapter IV should be studied in connexion with this part of the subject, as staining methods apply equally well to spirit varnishing so far as brushwork and general procedure are concerned. When using the polishing rubber between the coats, particular care is needed to avoid rubbing the varnish off sharp corners, which is very apt to occur, leaving the light wood exposed. The rubbing down is best done with a polishing rubber, using diluted polish for the purpose and introducing a little glaze in the final stage.

When treating ornamental work such as fretted loud-speaker fronts, etc., the edges should always be varnished before the broader flat surfaces, and to avoid the thin wood warping, both sides should be wetted evenly.

Spirit varnishing is intended as a cheaper type of finish than french polishing, but unless it is well done the results are apt to be of a very amateurish character. For good results, too, the polishing rubber cannot be entirely eliminated, and the process therefore becomes a compromise between polishing and varnishing.

For special methods of removing old varnish, see pages 97, 98, and 151.

# CHAPTER XII

## FINISHES FOR OAK

THE popularity of oak in modern furniture manufacture and its extensive use in many other directions indicate that a few pages should be devoted to the special treatment of the various finishes which can be applied to this wood. One reason for the great popularity of oak is probably because of the very wide range of effects that can be produced by skilful use of the finishing materials at our command. Oak will well take a wide variety of finishes, and as supplies of this wood at the present time are abundant, it is very much in demand for many purposes.

### CURIOUS EFFECTS

A number of somewhat unusual finishing effects are often to be seen in modern furniture, some of which might be described as freak finishes. It is now proposed to give some suggestions for producing a few of these effects, from which the reader may derive some ideas of his own. A little research and experiment along the lines suggested in the following paragraphs may be found worth while, and at any rate interesting.

Oak is an open-grained wood, and by manipulating a suitable grain filler and a contrasting stained background, striking results can be produced. Generally a white paste filler is used, the groundwork being obtained to some desired shade.

**Black Finish.** The surfaces of the work should be prepared in the usual way by glass-papering down to a perfectly level finish, free from defects. A stain may then be prepared by thinning down vegetable black with turpentine, with which the work may then be stained, using a piece of cotton fabric for the purpose. A sufficient number of coats should be given to produce a densely black result; but care is required, as the black is liable to lie on the surface like paint, and if such is the case it must be wiped off. When quite dry, a coat or two of white transparent polish to fasten the stain should be put on with a soft camel-hair brush. As an alternative to a turpentine stain, a spirit ebony stain or shoemakers' ink may be used. Any tendency of the grain to rise as the result of staining must of course be corrected by light glass-papering, as explained in Chapter IV. When perfectly dry, the grain may be filled in with a white paste filler, which should be well rubbed in. When perfectly hard, another coat of white transparent polish should be given, using a soft brush, after which the work should be set aside to harden thoroughly. Light glass-papering with a fine cut paper should then be given, after which french polishing may be proceeded with, using a transparent polish. Generally, work of this description is finished to an eggshell gloss. The result obtained will be a black ground with white streaks where the open grain has been filled with the white filler. Dining-tables and bedroom and hall furniture are occasionally finished in this style, although it does not appeal to all.

**Blue, Green, and Brown Finishes.** Instead of staining the work black, either blue, green, or chocolate-brown coloured stains may be used. These can be made up by thinning with turpentine any of the colours ground in oil, or alternatively spirit stains of the required colours can be used. After staining, a coat or two of white transparent polish should be given, after which the grain can be filled with a white paste filler, giving a further coat of white polish when the filling is hard. When the work is quite dry, it may be prepared for final polishing with a white transparent polish. The result will be a white speckled effect on a contrasting background, according to the colour chosen.

Another effect may be produced by bleaching the woodwork and then filling in the grain with a white paste filler and finally polishing with white transparent polish. If very light oak is used in the manufacture, bleaching may not be necessary and grain filling may be carried out at once, finishing off by polishing as directed above.

Common washing soda, when made into a strong solution with water, has the effect of darkening some varieties of oak, turning it a light chocolate-brown colour. Staining by this method, although cheap, has the disadvantage that the grain rises considerably and therefore needs correcting.

**Grey Oak or Silver Oak.** Some varieties of pine, poplar, and beech as well as oak can be treated by the following process so as to give a silver-grey effect. Chemical action is promoted by painting the surfaces first with a solution of half an ounce of silver nitrate in 20 oz. of water, followed by two coats of hydrochloric acid. After the latter applications, the work should be set aside to dry perfectly in the dark, as this has the effect of improving the appearance. It is finally necessary to paint over the work with common ammonia water, after which the work should be allowed to dry before polishing with white transparent polish. Generally, an eggshell finish is desirable for this class of work.

## FUMING

There is hardly a finish for oak which can be compared to fuming, particularly if the work is wax polished afterwards. The effect of wax polishing is to give a rich appearance to the work which cannot be surpassed by any other finish. It should be noted, however, that all varieties of oak are not affected to the same extent by fuming, and some do not colour at all.

The process consists of exposing the finished woodwork to strong ammonia fumes for a period depending upon the depth of colour required, which in turn will depend upon the rate of submission to the effect of the fumes. Ammonia specially manufactured for the work is obtainable from the usual sources or from large drug manufacturers. It has a specific gravity of 0·880, and is commonly known in trade circles as point eight-eighty ammonia. Great care must be exercised when using this fluid, as the fumes are exceedingly pungent and must not be inhaled, as they are poisonous. It is therefore advisable, in fact necessary, to perform the fuming operations in some outhouse or other convenient place where the fumes cannot be harmful.

Fuming is a dry process, and as such does not in any way cause the grain of the wood to rise. It is therefore a very convenient process from this point of view.

**General Procedure.** It is necessary to have, for small work, an air-tight box of sufficient size to contain the work to be fumed, and the box must be closed with a lid. A large packing crate, the joints of which can be sealed by sticking paper over them, will do well for a variety of small to medium-size work. To accommodate large pieces of furniture and other woodwork, a small room may be necessary. The latter should be fitted with adjustable ventilators which can be closed tightly while fuming operations are in progress. Into the box or room, as the case may be, the work must be so placed that the fumes can completely flow around it. Therefore it is as well to support the work on small blocks above the ground level or bottom of the box. Drawers and other fitments must be removed to allow free exposure of all parts to the fumes of the ammonia. Some means, too, must be adopted for examining the progress of the work, and for this purpose a window fitted with a piece of clear glass is suitable. Through this the work may be viewed and the effects of the fumes examined from time to time. Alternatively, when using a small box, a hole bored in one side at some convenient place, and through which a piece of wood of the same variety as that to be fumed can be fitted, is a convenient means of checking the progress of the work. The wooden test stick should be made to press tightly into the hole and to protrude well into the fume chamber. It can then be withdrawn periodically for inspection. When the test stick is of the desired colour, the work is complete. The ammonia should be poured into shallow bowls or dishes placed at suitable points so as to ensure all the work receiving full benefit of the fumes. As the latter are heavy, the lower parts of the work may darken more rapidly than the upper portions. It is therefore desirable, if the work is of considerable size, to arrange brackets on the fume chamber to support dishes of ammonia above the floor level. The point to aim at is to ensure, as far as possible, that an atmosphere of uniform density exists in the chamber, thus ensuring even colouring of the work.

It is impossible to give the exact time that is required for fuming, as it depends entirely upon the wood, some varieties darkening very quickly while others take much longer. The time required may be anything from one to ten or twelve hours. Since the wood from which an article is made may not respond evenly to the effects of the fumes, some means are necessary for checking those portions which reach the required shade of colour before other portions. This is conveniently done by giving the former a coat or two of white polish or wax. This will stop the effect of the fumes and allow the lighter parts to darken. When the work is of the desired shade of colour it should be removed from the fume chamber and be exposed to the open air to allow the ammonia fumes in the pores of the wood to disperse. After this treatment, a coat of linseed oil applied with a piece of soft fabric will improve the appearance of the work. This should be followed by a coat or two of white polish applied with a camel-hair brush. Finally, the work may be french polished or wax polished, the latter giving the most pleasing results if properly carried out as directed in Chapter IX.

The process of fuming is a particularly easy one, and results can hardly be other than successful. The only difficulty lies in regulating the colouring so as to preserve uniformity. When parts are darkened too much, bleaching is often resorted to, oxalic acid dissolved in methylated spirit being used as a bleaching agent. The acid and spirit should be applied warm to the dark places, using an old brush for the work. To neutralize the bleaching, vinegar is applied, after which the work must be allowed to dry. These two operations will undoubtedly raise the grain, necessitating light glass-papering to restore the surface. It should also be mentioned that before the work is placed in the fume chamber, all grease marks or splashes of oil must be carefully and completely removed, as any such marks will check or even prevent the fumes from taking effect.

**Varieties of Oak Suitable for Fuming.** As mentioned previously, all kinds of oak will not change colour under the influence of ammonia fumes. American and Canadian oak are generally unaffected by long exposure to ammonia fumes. If, therefore, it is necessary to colour this wood to match other oak that has been fumed, this may be done by staining. Several makers market what is called fumed oak stain, and a good deal of work which is sold as fumed is not really fumed at all but merely stained by one of these proprietary stains.

JAPANESE OAK. This wood fumes well and darkens fairly quickly to a rich brown colour. When wax polished, a very fine result is obtained. To test the effect of fuming on any variety of oak it is only necessary to cut sample strips of the wood and hold them for a short time over the uncorked bottle of ammonia or by pouring a little into a dish. It is as well to make this test always if the work is to be finished by this process.

RUSSIAN AND AUSTRIAN OAK. A good deal of either of these two varieties will, when fumed, turn to a very rich greenish colour, and when wax polished, give very distinctive effects. To match up such work, any of the proprietary green spirit stains of the desired shade may be used, or alternatively a green pigment mixed with methylated spirit will do. Aniline green powdered dyes, when mixed with white polish and stained, will also give a rather bright green colour if this may be required, while it can be toned down by adding blue or black spirit stain. Aniline dyes are very powerful, and therefore very little will, in general, be required to produce a strong colour.

DARK BROWN OAK. Dark brown oak of the so-called Jacobean colour, much of which is now on the market, is stained a dark brown colour by spirit and naphtha stains. An easily made stain for producing this shade of colour can be made by mixing brown umber in oil with turpentine and applying with a rag. As some of the umber is liable to remain in suspension in the turpentine, it must not be allowed to lie on the work as a paint but must be carefully wiped off. Either a wax or french-polish finish is suitable for this type of work, while distinctive effects may be produced by using dark or lighter grain fillers after staining. Dark brown oak is often produced by dyeing french polish, which is then applied with a brush. The polish is dyed by steeping about half a tablespoonful of vandyke brown powder mixed with half a small teaspoonful of vegetable black into diluted french polish. A convenient way of dyeing the polish is to tie the two dyeing materials in a piece of fabric, which can then be immersed in the polish and finally squeezed out. The polish should not be too dark, as the depth of colour of the work can be regulated by giving as many coats as required. When the work has been so stained, it should be set aside to dry thoroughly, after which a coat of standard polish should be given to the work to fasten the stain. Finally, the work may be finished with wax or french polish.

FLEMISH OAK. This title refers rather to a style of finish and method of cutting the timber rather than to a particular variety of oak. The familiar coffee-coloured wood seen in churches and cathedrals is stained by a solution of bichromate of potash and water. About 1 lb. of the former to 2 gallons of water is required, which is applied with a stiff bristle brush. When quite dry the grain will be, of course, raised by the action of the water, and must be reduced by fine cut glass-paper. A coat of black japan thinned well with turpentine should then be applied to the stained surfaces, being well wiped off, after which a coat or two of orange shellac should be put on. The work should be well glass-papered down between the coats, and when quite hard should be rubbed down with pumice powder and linseed oil to produce a good surface. No further treatment is necessary for this class of work, and too much pumice powder should not be applied, as the pores of the wood should not be entirely filled up. The wood used for purposes demanding a finish of this description is usually sawn on the quarter.

**Other Finishes for Oak.** Many other methods for staining and finishing oak have been devised, and the reader is recommended to do a little experimental work for himself in order to determine the methods of producing any desired effects.

Bichromate of potash is commonly used as a stain for oak, while burnt umber and drop black are used as fillers to give contrasting effects. Antique effects may be produced by staining with ammonia diluted with water or by using a stain made by stirring iron filings in vinegar or acetic acid. Permanganate of potash mixed in water to the extent of about ¼ lb. of the former to a gallon of the latter makes a good brown stain suitable for a wax polish finish. In all cases where water is used in making the staining solutions, the grain will rise; hence, between the coats of stain and prior to polishing, glass-papering must be resorted to. Many proprietary spirit stains in a range of colours are also on the market for staining oak, while various effects can be produced by the use of aniline dyes.

The foregoing remarks referring to oak finishes are not, of course, exhaustive, but it is hoped that sufficient data have been given to enable a good range of finishes to be obtained and that sufficient reference has been made to various processes to stimulate interest in the subject, thus enabling a little research to be undertaken. For who knows? A striking finishing effect for this popular wood may capture a big market.

# CHAPTER XIII

## REMEDYING FAULTS IN POLISHING AND VARNISHING

THIS part of the subject might be conveniently divided into two sections: (*a*) The defects arising as the result of errors of workmanship and the use of unsuitable materials; (*b*) Defects and blemishes occurring ultimately, due to local effects. Defects falling within the former category need for a cure the revision of the methods of working and possibly of the materials used, since these may be unsuitable. Those defects falling within the latter category, however, may require treatment involving a piece of repair work requiring a good deal of skill and ingenuity. While it is quite impossible to enumerate within these pages all likely defects and their correction, some of the most common will be considered in detail.

**Sweating of Polished Work.** It has been emphasized repeatedly in the course of this book that when using oil, either as a means of improving the appearance of the figure of the wood or as a lubricant, it must be applied to the surfaces as sparingly as possible. One of the most common faults in this class of work is that known as sweating and is directly traceable to the use of too much oil. As a result, the excess oil used ultimately breaks through the polish and continues to show itself through the broken surfaces until the oil has completely dried out. This may, however, take a long time, and to hasten the drying process it is usual to treat the surfaces affected by applying a liquid corrective, while serious cases may require rubbing down and repolishing. A common method of treating sweaty work is to make up a cream consisting of about a gill of paraffin mixed with half a gill of vinegar and half a tablespoonful of methylated spirit. Into this, about half an ounce of butter of antimony is mixed, the resulting cream being applied to the affected work by means of a pad of cotton wool covered with a piece of soft fabric. Alternatively, equal percentages of raw linseed oil and lime water mixed with about 1 per cent methylated spirit is sometimes used. If, after polishing, the work shows a misty or milky appearance, it is also an indication that too much oil has been used during the polishing process. Not only is sweating caused by the use of too much oil, but it may also be produced as the result of using inferior methylated spirit or poor polish. Sweating can often be attributed to the use of ingredients of a too greasy nature, which may have been used in the preparation of the materials required for the several processes involved in producing a polished surface. By using high-grade materials, however, much trouble of this sort can be avoided. Occasionally, sweating preventives are used in the polish, generally in the form of an additional gum. A small percentage of gum copal dissolved in strong alcohol and added to the polish is an effective remedy for sweating, although it tends to make the working of the polish rather more difficult.

Another cause of sweating is the application of one coat of polish on top of another before the previous one has hardened. Brush-polished work is particularly susceptible to this defect, and when engaged on this process ample time must be allowed between the coats for drying out, and only good-quality polish should be used. Cheap material may prove expensive in the long run.

**Dampness.** Generally, this is a temporary and not very serious defect, and is largely due to changes in the humidity of the atmosphere owing to temperature. Dampness may cause dullness of the surfaces; if it persists, it would tend to accelerate the deterioration of the polish. A little furniture cream of good make, applied with a piece of soft fabric, will remove dampness and generally revive the surfaces affected.

**Cracking.** This defect occurs ultimately in most polished work, although when of a high-class finish the work should give years of service before deterioration of this nature begins. The cracks common to polished work are generally of a very fine hair-like appearance, and are the result of one or a combination of the following causes—

(*a*) Expansion and shrinkage of the timber, due either to insufficient seasoning or, in the case of old work, to the almost inevitable shrinkage due to age.

(*b*) The presence of soda or other strong alkali under the upper film of polish.

(*c*) A hard surface under which may be a comparatively soft elastic body.

(*d*) Repolishing on a hard foundation of old polish.

Cracking may in some cases be somewhat local in character, but generally extends over a wide surface, myriads of fine cracks spreading out in all directions.

**Unseasoned Wood.** It is difficult to correct faults due to the use of unsuitable timber, but if it be known that shrinking is likely to occur to any considerable extent, then the more elastic must be the finish, otherwise cracking is certain. Hard polish should not be used, and the final polishing should be by simple spiriting out. In the case of old work which has to be repolished, cracking will not occur, due to the timber being unseasoned, but particular care is needed in this class of work, which is very prone to cracking, and the chief causes of this defect will be mentioned in the following paragraphs.

**Cracking Due to the Use of Strong Alkalis.** Generally, cracking due to this cause occurs in work which has been repolished, the old polish having been removed either wholly or partially by means of common washing soda or other "remover" of a strongly alkaline nature. Unless the work is thoroughly well rinsed after having been treated with these strong solutions, the alkali will attack the film of new polish from the under side and gradually destroy the foundation, causing the outside surface to crack, and perhaps break down completely. On the other hand, if the old polish has not been entirely removed and the material used for partially cleaning not well rinsed, then the old polish left, on which the new body is built, is liable to be destroyed, causing the newly formed surface to crack. Soap also contains a certain amount of alkali which may prove to be a source of trouble, and therefore if this material is used for cleansing it should be well rinsed off.

**Hard Polish.** A hard surface such as is produced by the acid finish described in Chapter V is always likely to crack in the the course of time, and it is not uncommon to see old pianoforte cases suffering from this defect. Pianoforte cases are often finished by this process, particularly those imported from the Continent. We are not, however, concerned here with cracking which may occur after a reasonable amount of service has been obtained, but rather to suggest ways of preventing this defect occurring before such service has been obtained. Repolishing on top of a hard surface, such as would exist on work finished by the acid process, needs careful execution. To guard against cracking, it is advisable to soften the old polish if it has not been entirely removed. This can be conveniently done by applying a few light coats of weak polish before starting on the bodying-up process. This treatment will provide a softer foundation on which an elastic body may be developed; and when the polishing is completed, instead of having a comparatively soft surface on a hard foundation, the whole is more homogeneous. If the two last points are carefully studied and care taken in the directions indicated, trouble due to cracking will be greatly reduced.

**Defective Materials.** French polish can now be purchased in a variety of grades to suit almost all requirements, and as these can be obtained with a guarantee, no danger of trouble exists from the use of faulty materials if supplies are obtained from a reliable source and the materials fairly handled. The chief danger, however, occurs if materials are mixed, and it is therefore advisable to purchase methylated spirit, which is required for diluting polish and spiriting out, from the same source of supply as the polish. Methylated spirit varies considerably, and the mixing of two different stocks may give rise to cracking of the polished work and other defects. Polishes of different grades should never be mixed, for similar reasons.

**Treatment of Cracked Surfaces.** Any badly cracked surface will need repolishing: it cannot be recovered in any other way. In such circumstances it will first be necessary to rub down the surfaces affected by means of pumice powder and water, and when perfectly flat they may be repolished as directed, care being taken to avoid ridging, which may result if the old polish is wetted too much. The rubbers should be well worked out before being recharged. Surfaces which are not badly cracked may be revived by first washing down with hot soda water and afterwards well rinsing. The surfaces should then be dried with a chamois leather and given a wipe over with a fabric pad dipped in raw linseed oil, as little of the latter as possible being used.

The oil should be well wiped out, after which a coat or two of weak polish may be given to soften the undercoat. When dry, the work of bodying up and spiriting out may be proceeded with as directed in Chapter V.

**Lack of Lustre.** French-polished work will occasionally lose its lustre after a day or two. Generally speaking, there are two causes of this defect, namely too much oil having been used (or oil of the wrong kind), and using the spirit rubber too wet. The latter causes the undercoats to move and give rise to patchy results. In regard to the former cause, excess oil will produce several defects, some of which have already been mentioned, while only raw linseed oil or poppy oil should be used as a lubricant. The latter is preferred by many workers, since it is claimed that troubles of the type mentioned are less likely to occur.

**Faded Work.** Fading is not as a rule a defect due to indifferent workmanship, but rather a condition resulting from the effect of exposure to the sun and to a lesser extent due to continual dampness. To restore faded surfaces it is necessary to remove the upper surface of polish, which may be effected by light glass-papering, having previously washed the surfaces with a weak solution of common soda and warm water. Fine cut glass-paper partially worn is best suited for the rubbing down, although pumice powder and water are sometimes used. After rubbing down, the faded surface will be exposed, and it may then be matched up to the rest of the work by staining. When the stain is thoroughly dry, repolishing may be proceeded with according to the instructions already detailed. Sheraton mahogany is particularly susceptible to the effects of the sun, and such work should be adequately protected to preserve its appearance.

**Greasiness.** If after a few days from completion the work feels greasy and readily shows marks when touched, then this is direct evidence that too much oil has been used during the polishing processes or that the gums from which the polish has been made were not of hard quality. Good lac dissolved in good-quality methylated spirit should be quite hard when dry. A wash down with weak soda water, after which further polishing may be resorted to, will correct this defect if very little oil is used on the rubber when polishing. Occasionally benzoline is applied to remove grease, a rag being used for the purpose, after which repolishing is necessary as before.

**Scratches.** The renovation of scratches is one of the most common pieces of repair work that a polisher is called upon to perform. The successful covering up of scratches and similar damage to polished surfaces calls for considerable skill and experience, particularly if the repair is to be of a local character. The removal of scratches generally means that a sufficient depth of polish has to be removed so that the bottom of the scratch or other similar defect may be reached, or if the blemish is so deep that the wood has been penetrated, then the polish must be removed to the level of the wood, the latter then being filled in with a suitably coloured filling, the work matched up, and finally repolished.

Polish is best removed by means of a sharp scraper and fine glass-paper, after which the exposed surface will require matching up to the surrounding work, levelling and repolishing. To make a local repair of this sort is by no means easy; generally speaking, the best way to effect repair to a badly scratched surface is to repolish it completely. One or two tricks are employed to reduce the prominence of scratches which are not very deep. A shallow scratch exposes a whiteness as compared to the normal background of the polished work. It is common practice, therefore, to repair the colour rather than the scratch, which is usually done by means of a little linseed oil applied with either a small soft-hair brush or a piece of rag. When the oil is quite dry, one or two rubbers of polish should be well worked out on the affected surfaces. Sometimes light scratches are reduced by means of heat. A wet rag is placed over the damaged part of the work and a hot iron applied to it with the object of causing sufficient of the polish to swell and thus fill the scratch. Repolishing after this treatment is, of course, necessary. The process just described cannot be very strongly recommended, as further damage can be too easily inflicted, particularly if the iron is applied when too hot. In conclusion, it should be observed that a skilful worker may be able, by an artifice, to effect a repair cheaply; but in the long run it is often cheaper to repolish completely a badly scratched surface. This may not necessarily mean the complete removal of all the old polish down to the level of the wood; much, of course, will depend upon the depth of the scratches.

The hot-iron method just referred to is used as a means of reducing blisters which occasionally occur on french-polished work. Alternatively, they can be removed by rubbing down with fine glass-paper wetted with a little linseed oil, after which the work will require matching up and repolishing. The matching up can probably be done by working out a rubber or two of suitably coloured polish in the early stages of the repolishing.

**White Patches.** Stained work in particular is susceptible to discoloration, which really takes the form of light patches, veins, or narrow streaks. Defects of this nature are commonly found on water-stained work, and point to the fact that the polishing was commenced before the stain had thoroughly dried out. Work which has been polished in a damp atmosphere is also liable to suffer from this defect. Another cause of light patches is the presence of lime, which is commonly introduced to the work by way of the plaster of Paris used in the filling process. The lime gradually attacks the stain after polishing and bleaches it, leaving light patches which can only be rectified by removing the upper films of polish, matching up the work, and then repolishing.

Bleaching agents, if not properly neutralized, form another source of trouble. Oxalic acid is commonly used for bleaching purposes and *must* always be neutralized with vinegar, otherwise unsatisfactory results are always liable to occur. Restaining and repolishing are the only effective remedies for these troubles if of a serious character, although attempts are sometimes made to restore the work to its original colour without the expense and trouble of a repolish. One common method is to take the work into a warm atmosphere, well rub it down with a piece of flannel which has been moistened with a mixture of 50 per cent each of raw linseed oil and methylated spirit. Following this treatment, a coat or two of polish should be applied, to which may be added some suitable stain for restoring the colour. Repolishing in the ordinary way may be proceeded with after this treatment, or the work may be finished by means of a coat of good-quality spirit varnish.

**Dark Patches.** The restoration of dark patches to the original colour can sometimes be effected by wiping the affected portion with a rag moistened with benzoline. Generally this method is only effective in cases where the discoloration has been caused by oil of one kind or another having been spilled or dropped on the polished surfaces. Otherwise, oxalic acid dissolved in water may be used as a bleaching agent. After treating the work with the acid solution it must be well washed with clean water and then neutralized with soda water. Repolishing may be necessary, particularly if the acid is used too strong.

**Stains in General.** Most stains, including those caused by ink, can be removed by the use of oxalic acid. The action of the latter is to bleach the work, and hence after treatment it will require matching up and repolishing. Deep stains may be removed by repeated applications of oxalic acid concentrated in the affected portions. A pad of wool, cut to the size of the mark to be removed and soaked with oxalic acid, is a convenient means of concentrating the acid on the particular locality under treatment.

**Stains Produced by Water.** Water dropped on to a french-polished surface will, if not wiped off immediately, generally mark the surface. Any surfaces on to which water is likely to be spilled in the course of everyday use should be finished with a hard polish, or preferably should be either oil varnished or oil polished. Neither of these latter finishes is so susceptible to damage by water. A french-polished surface so damaged may, however, be repaired by rubbing down with the mixture of linseed oil and methylated spirit referred to in the treatment of white marks. To remove any oiliness produced by this treatment, the surfaces may be wiped over with a little benzoline.

**Ship's Furniture and Fittings.** Except for ship's furniture and interior decoration, french polish should never be used on work which is exposed to the effects of sea water or a salt atmosphere. Either of the latter will quickly destroy an ordinary french-polished surface, and in consequence oil varnish is invariably used, of which there are several varieties manufactured for this particular class of work. Furniture which may have to be subjected, as at the seaside, to a salt atmosphere can be polished with a waterproof polish, and a heavy body worked up before the final finishing is attempted. Polishes especially prepared for work subjected to the conditions mentioned are obtainable, and generally contain, in addition to the ordinary lac, such gums as animi, benzoin, and sandarac, together with some oil. Furniture which may be affected by salt water or sea air can be revived by rubbing down with pumice powder and oil to remove the upper layer of polish, after which a coat or two of waterproof polish should be applied and the work so finished off.

## DEFECTS OCCURRING IN OIL-VARNISHED WORK

**Blooming.** This is one of the commonest defects to which oil-varnished work is subjected, and is readily detected by the presence on the surfaces of a whitish misty film. The film may be permanent, or may appear at intervals and then clear off. Any good-quality hard varnish which dries very glossy is susceptible to blooming, since such surfaces offer to the atmosphere a ready means for condensation of the water vapour in the atmosphere to take place. Bloom arises as a result of moisture accumulating on the varnished surface before it has thoroughly hardened off, or it may be due to the presence of moisture in the varnish itself. To mitigate the occurrence of bloom it is therefore necessary to avoid varnishing in a damp atmosphere, and also to take care not to leave the varnish bottle uncorked or stored in a damp place. It follows that within reasonable limits it is advisable to do varnishing in an atmosphere which will enable it to dry quickly in order to avoid the possibility of condensation due to a change of temperature which is bound to take place over an extended period, particularly if there is no artificial heating.

Work which exhibits bloom may sometimes be remedied by warming and rubbing down with oil and a little vinegar, the rubbing being continued until the surface is quite dry. Alternatively, the affected portions may be washed down with a sponge and warm water and allowed to dry thoroughly, after which the work should be well rubbed down with a piece of felt on to which olive oil is sprinkled. These remedies are only likely to be effective when the blooming is due to the work having been originally carried out in a damp atmosphere. If it is defective as the result of the use of contaminated varnish, there is but one thing to do, and that is to revarnish the work. The affected varnish must, of course, be removed, and this may be done by means of ammonia or one of the proprietary removers now marketed.

**Blisters.** These are commonly found on work exposed to heat, either natural or artificial. They arise as the result of the vaporization of moisture trapped between the undercoats of varnish, causing expansion, which raises locally one or more of the upper coats, thus forming blisters. There is no way of satisfactorily reducing blisters beyond rubbing them down perfectly level with glass-paper and revarnishing. Since there is always bound to be a certain amount of moisture of one sort or another present in woodwork, it is advisable where possible to protect varnished woodwork from the direct rays of the midday sun.

**Cracks.** Cracks in a varnished surface indicate that the varnish is not homogeneous, a condition often arising as the result of mixing different varnishes having different elasticities: the practice of mixing varnishes must, of course, be condemned. The placing of a hard varnish on top of a more elastic undercoat will also produce cracks due to unequal expansion, while varnish containing an excess of turpentine is also liable to these defects. Hence, to avoid cracking, do not dilute varnish with excessive turpentine, and ensure that the coats of varnish applied are of uniform elasticity. A surface which has cracked may be rectified by rubbing down with glass-paper and then revarnishing, provided the surfaces are not deeply affected. In the latter event, complete removal may be necessary. Shrinkage of the upper coats of varnish due to the sun's heat will also give rise to cracking.

**Cissing and Pitting.** The former defect is produced by local shrinkage arising from the presence of patches of oil or as the result of not filling small holes. The varnish tends to recede from these blemishes and leaves a defect commonly known as a "ciss." Thorough preparation of the surfaces before varnishing is a sure guard against this fault.

Pitting is a defect resulting from the presence of an excess of turpentine in the varnish, or it may be due to the varnishing having been carried out in an excessively moist atmosphere. While cissing is a ground defect, pitting occurs in the body of the varnish itself. Rubbing down and revarnishing are the only cures for a badly affected surface. Beware of using a varnish brush which has been washed out in turpentine and not thoroughly dried.

**Creeping, Crinking, or Wrinkles.** These are more or less synonymous terms applied to a defect occurring as the result of the too liberal use of varnish or as the result of using the varnish in a too viscous condition. The latter generally gives rise to the former, making levelling-off a difficult process. Creeping is often caused by the presence of grease on the groundwork and also by varnishing in too low a temperature.

Revarnishing after cleaning off is the only satisfactory cure for these defects.

**Uneven Lustre.** This arises as the result of unequal absorption of the wood, due possibly to insufficient priming. Generally, defects of this nature can be rectified by additional coats of varnish.

**Perishing and Loss of Brilliance.** This is commonly caused by the treatment of varnished work during use. The too frequent use of hot strong soda water for cleansing purposes will cause premature perishing and loss of brilliance, while exposure to continual dampness, effects of sea air, ammonia, and coal and other gases will produce similar results.

**Ropy Surfaces.** Defects of this nature can generally be traced to the improper storage of the varnish. If the latter is kept in a cold, damp atmosphere, it is almost certain to become ropy when applied in an atmosphere normal to varnishing. Old varnish also is liable to produce this defect. The storage of varnish in a place where the temperature is constant and where the atmosphere is dry is important and a guard against this defect.

**Difficulty in Drying.** Little difficulty will be experienced in regard to drying if varnish of good quality is used, always provided the surfaces are properly prepared and free from grease. The latter will very definitely prevent drying off. Lime water will kill grease, and any work which is affected by grease should be washed over with lime water, benzoline, or washing soda and water. Attention should be paid to the varnish brush, which should be thoroughly clean and free from oil. Varnished work which persists in remaining sticky should be given a coat of good varnish.

**Polishing Oil-varnished Work.** Good-quality varnished work which has lost its lustre can be revived by rubbing over with a mixture of vinegar, turpentine, and linseed oil, the mixture being applied by means of a soft fluffless rag, finally polishing the work with a chamois leather. Frequent rubbings with the latter will aid in keeping varnished work in good condition.

**French Polishing on Varnished Surfaces.** Owing to the great difference in the elasticities of french polish and oil varnish, it is not a practical proposition to french polish any type of oil-varnished surface. It is possible, however, to french polish with success some varnishes specially marketed for such purposes.

**To Avoid Defects.** As a final summing-up, a few hints may be appreciated which if studied carefully and practised will reduce the risk of defects occurring in the finished work. Cleanliness is all-important, and its need cannot be overemphasized, while grease and surface defects must be seriously attended to. When applying varnish, do not rub it too much with the brush, but apply it sufficiently liberally to avoid its running off the surfaces. Avoid varnish which is too viscous, as defects will arise which cannot be easily corrected. When applying varnish, aim at even distribution and level off carefully before leaving the surface to dry, working as near as possible in one direction only, and not in a criss-cross fashion. Care is required when dealing with quirks, mouldings, and ordinary corners, as at these places the varnish is liable to collect and make an unsightly mess. When laying on undercoats which have to be rubbed down, rather less varnish should be used, so that a hard surface suitable for rubbing down is readily obtained without the risk of the varnish picking up. The varnishing of broad surfaces presents some difficulty. It is essential to work in a systematic fashion in steps and keep unfinished edges "alive," so that when the next strip is started the last edge is not too sticky to prevent even flowing together. Good-quality work cannot be produced with fewer than three or four coats of varnish, and the preliminary one should be well rubbed down with pumice powder and felt or fine carborundum powder and water. The indiscriminate mixing of varnishes should be avoided, as, unless the effects of such mixing are known, serious defects may arise. To obtain special results, such as an eggshell gloss, flatting varnish and fine copal may be mixed; here the result is definitely known. Do not add raw linseed oil or turpentine in the free state to varnish, but use thinners if necessary. To obtain a fine gloss a highly skilled process known as double coating is often employed as a substitute for felting down. The process consists of applying an additional coat before the previous one is quite dry. Light, rapid working of the additional coat is necessary, which must not cause the under one to pick up, and in this respect great skill is required. The less hard the undercoat, the more glossy will be the final result. If felting down is to be resorted to, it is necessary to use a hard-drying varnish. Finally, use good brushes, for good work cannot be produced with inferior tools, which, although cheaper, are expensive in the long run.

# CHAPTER XIV

## BRUSHES

Brushes are used extensively in the finishing trades, although so far as french polishing and the allied processes are concerned, the brush takes second place to the rubber. They are important tools, however, and some details of their manufacture and use will be given in the following pages.

With respect to size, weight, and composition, brushes present one of the most deceptive of manufactured products, and it is often very difficult even for an experienced person to determine the true value of a brush. Some knowledge of the materials used and the method of manufacture may therefore be of some help in this matter. Years ago, the materials available for brush manufacture were somewhat restricted, but of late the range of materials used has increased very considerably.

The hairy coats of very many animals together with various vegetable fibres are now used, the price range of these materials being very wide. The most important animal hairs used in brush making are those of the badger, bear, goat, horse, marten, ox, pig, sable, skunk, and squirrel, while split whalebone and the fibrous portions of the whale fins are also used. Vegetable fibres used are numerous and include bass, bassin, cane, coco, kitool, and Mexican fibre, while synthetic fibre has recently been introduced in which celluloid and rubber are largely employed. For varnishing, and incidentally painting and distempering, the best brushes are made from one material only, namely pig's hair or bristles, which is the correct term for this particular hair. To reduce the cost, however, horsehair and fibre are incorporated with the bristles in lower-grade brushes. The most important materials used in brush manufacture are bristles obtained exclusively from the boar, hog, or pig, and are selected from these animals inhabiting the more northerly parts of Europe and Asia, for it is from these that the best-quality hair is procured. Russia, China, and India provide the best stocks of bristles, although quantities are imported from American states but of inferior quality. While it is a fact that animals from the colder climates generally provide the best bristles, the breed of animal also has a good deal to do with the ultimate value of the bristle. The chief characteristics which make pig bristles most suitable for brush manufacture are elasticity, strength, wearing ability, and absorbent power. The fine ends of the bristles also tend to split, a feature peculiar to pig's hair, thus making the end of the brush soft and able to produce even and smooth working. The fine end of the bristle is called the flag, and this enlarges toward the root, one of the facts which enables pure pig's hair to be detected. The outer skin of the bristle, known as the follicle, is serrated like a saw, a characteristic common to most animal hair, but very pronounced in the case of the hair of the pig. The serrations are such that if a hair is stroked both ways with the fingers, it tends to move in one direction, a feature which is important to the brush manufacturer. The direction of the teeth is towards the fine end of the bristle, which makes the dislodgment from the ferrule more unlikely during usage and also prevents the bristles from falling out. Any bristles which happen to be reversed in the ferrule will fall out, as it is almost impossible to hold them by the flag end. The natural tendency of pig's bristle to curl is also of some help to the brush manufacturer, as some brushes require to turn in or out, while if the bristles are required to lie perfectly straight, all curling tendency must be taken out.

Bristles are by no means indestructible, and consequently great care is needed to keep a brush in good condition.

Dampness is one of the chief causes of bristle rot, and therefore brushes should always be stored in a dry place, while the action of alkaline solutions is to reduce the hair to jelly in a very short time. Damage by insects also occurs, the chief being due to the moth which lays its eggs in the flag end of the bristles, the resulting grubs feeding on them.

Bristles are very expensive, their value depending upon length, colour, and natural stiffness, the length ranging from 2 in. to 7 in., the colour varying from white to black, and the stiffness through a very wide range. White bristles are commonly known in the trade as "lily bristles," and these are very highly priced, the best Russian lily bristles 6 in. long costing as much as £20 per pound, while at the other end of the scale the short grey bristles cost about 3s. per pound. Generally speaking, the long bristles required for the manufacture of large brushes cost anything from 4s. to 45s. or 50s. per pound.

From the preceding remarks it is obvious that many of the cheap brushes on the market cannot be made from the best materials, and as a matter of fact adulteration and the use of cheaper and inferior materials are commonly practised. The two most commonly used materials for adulteration are horsehair and fibre. They do not, however, possess those properties referred to which make bristles most suitable for brush manufacture. Horsehair, commonly known as "drafts," is selected from the tail and mane of the animal, then straightened out and sorted into lengths ranging from 5 in. to a yard. Horsehair has a slightly serrated follicle, but except for the common characteristics due to its animal derivation, it possesses none of the properties of bristle such as split ends, which makes the bristle so valuable. Furthermore, it is straight, and thus having no taper or flag end it is a fairly easy matter to detect horsehair. Mexican fibre is the second most important material used for the adulteration of brushes. It is a fibrous growth

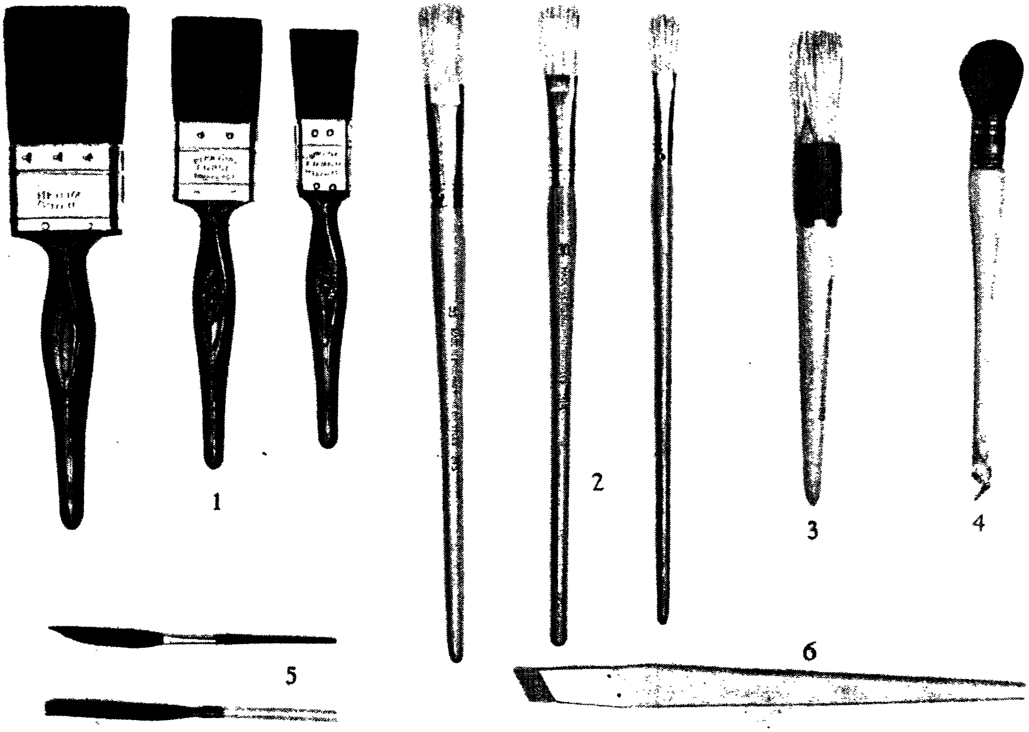

Fig. 12. Typical Examples of Brushes

found in the stems of the aloe and is imported into this country in its raw state, after which it is graded into lengths of 6 in. to 30 in., cleaned, combed, and dyed. It has none of the characteristics of bristles, being neither tapered, serrated, nor possessing the splitting tendency. Mexican fibre is comparatively cheap, costing from 5d. to 1s. per pound, and irrespective of its lack of useful properties compared to bristles, it has one important one so far as french polishers are concerned: it is not affected by strong alkaline solutions like all animal hair, which is attacked and ultimately destroyed by them. Fibre brushes are therefore valuable for applying solutions for the removal of old varnish or polish, for which strong caustic is commonly employed.

Other materials are used in brush manufacture, such as long badger hair employed largely in the making of grainers' softening tools. The tails of the sable and marten are used for pencils and liners, while sable hair is often adulterated with ox hair on account of the lower cost of the latter compared with the former. "Camel" hair is obtained from the tails of squirrels and is used for making gilders' mops, liners, and writers, and also lacquer brushes. Squirrel hair is adulterated with goat hair to reduce cost, while the cheapest types of these brushes are made entirely of goat hair. The hair of the skunk is often used in the manufacture of flat varnish brushes.

Referring to Fig. 12, typical examples of brushes are shown which are used in the finishing processes referred to in these pages. Group 1 shows examples of flat varnish brushes for small to medium-size work. They are rectangular in cross-section, the thickness being considerably less than the breadth. Generally, five brushes complete the set which range in size from 1 in. to 3 in. in breadth, the dimension by which the size of the brush is specified. Group 2 illustrates small flattish hog's-hair tools suitable for staining work of various kinds. The third example is a common sash tool, while the fourth shows a camel-hair gilder's mop, both examples having been referred to in earlier chapters. The fifth group shows two pencils, the upper one being a camel-hair striper, while the lower one is a goose liner or tracer mounted in a quill. These are examples of brushes used for small decorative work, and the cutting-in of transfers, etc. The sixth example shows a hog's-hair liner or cutting tool, which is useful for staining work where corners have to be negotiated, while it is also useful for cutting cleanly up to joints, etc. Brushes are, of course, manufactured for a very great variety of purposes, the range of types and sizes being very large indeed, so that the few here illustrated are only typical examples used in this particular class of work. Fig. 13 shows a type of varnish brush for large work.

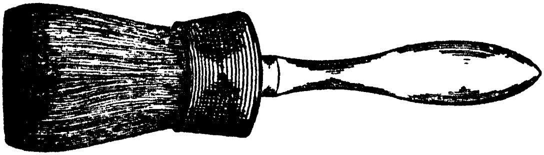

FIG. 13. OVAL BEVELLED VARNISH BRUSH FOR COVERING LARGE SURFACES

**Stippler.** This is a large brush, generally of rectangular shape, having stiff bristles all of equal length. The handle takes the form of a leather strap fixed at both ends to form a loop on the brush back through which the hand can pass. The sides of the brush are gripped by the fingers and thumb, the strap passing over the back of the hand. Any brush with stiff bristles will fulfil the purpose of a stippler, although special brushes as described are made for this work. The use of the stippler is described on page 56.

**Care and Treatment of Brushes.** A good deal of unnecessary waste and consequent expense can be avoided by taking proper care of these expensive tools. In respect to new brushes, considerable difficulty is often experienced on account of the hairs falling out. This apparent defect does not necessarily indicate that the brush is either a cheap one or one improperly made. Cheap brushes are always liable to this defect, which is due to the bad fixing of the hair in the ferrule. A good-quality new brush will, however, shed only the short hairs, of which there are bound to be a few. It is good practice to work a new brush over a rough piece of wood before beginning any particular job: this will eliminate the short and loose hairs. If the bristles continue to fall out, then either the cement used for securing them in the ferrule is unsuitable or the materials used as a whole are unsuitable.

The storage of brushes is important, and a few hints in this direction will no doubt be appreciated. Paint brushes, for example, should be kept in clean water when not in use, sufficient of the latter to cover only the bristles. Varnish brushes are best kept in linseed oil, which, of course, must be well cleaned out before the brush is put into the varnish. Brushes should never be left in turpentine, which has the effect of hardening the bristles, causing them to break. Brushes kept in turpentine are harsh in action, and their life is greatly reduced by such treatment. Brushes used for colour washing or distempering should be thoroughly washed out in water after being used and stored in a clean, dry place. The materials from which colour wash and distemper are made tend to harden the bristles of a brush, causing them to break off. Hence the need for thorough washing and rinsing before storing.

**Power Brushes.** The application of paint and varnish to large surfaces by means of power brushes is now fairly common practice. These brushes are hand operated but are kept charged automatically, which therefore eliminates the necessity for dipping the brush into the paint or varnish. The Bromak power brush shown in Fig. 14 is an example which

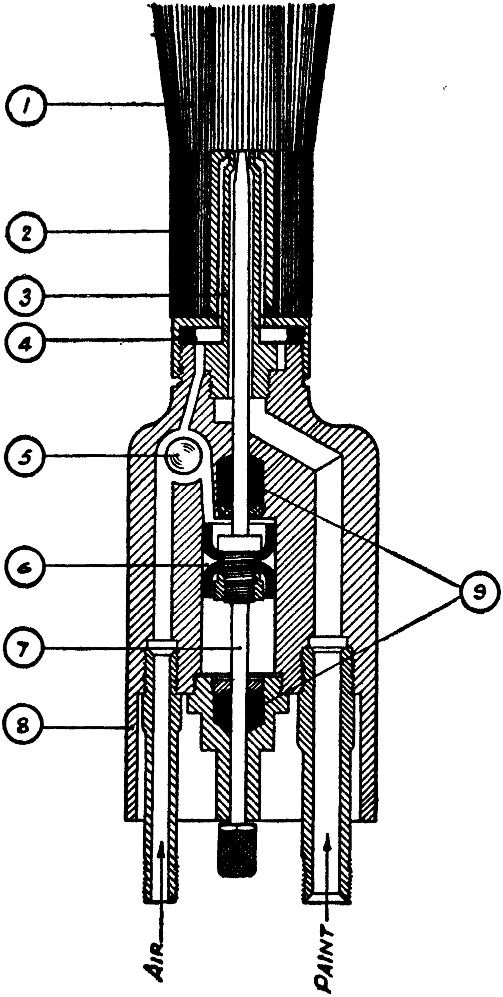

FIG. 14. BROMAK POWER BRUSH

| | |
|---|---|
| 1. Brush tip | 5. Ball valve (air) |
| 2. Brush stock | 6. Piston |
| 3. Inner nozzle | 7. Needle valve |
| 4. Adapter ring | 8. Hand piece |

9. Packing rings

incorporates a pneumatic power device for keeping the brush charged. These brushes are suitable for applying paint and similar materials of slow-drying nature, and a considerable time saving is effected in covering the large surfaces for which they are intended. The plant consists of a portable air compressor which is connected by flexible piping to a light metal container into which the paint kettle or varnish pot is placed (Fig. 15). The paint pipe, fitted to the pressure-tight cover of the container, is connected directly to the brush hand piece, and through this the paint is forced by the air pressure maintained within the container. The hand piece, which is very light (it weighs only 4¼ oz.), is fitted with a paint control valve operated by pressing a button conveniently situated, so that

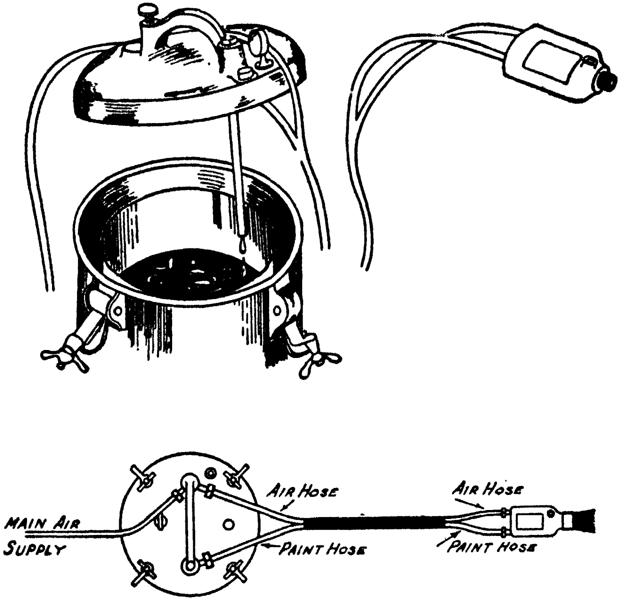

FIG. 15. CONTAINER AND PIPE LINES FOR BROMAK POWER BRUSH

the operator can charge the brush at will without lifting it from the surface. Brushes of various shapes and sizes for different types of work can be easily screwed to the hand piece when required, and long lengths of hose pipe can be fitted for long reach if necessary. The air compressors are driven either by an electric motor or a petrol engine, the compressor and engine being mounted on a trolley. For operating two brushes, a motor of about one-third horse-power is required to drive the compressor, while larger units for two or three operators working from 100 ft. to 200 ft. away from the compressor require a three-quarter horse-power motor. The amount of air required for each brush is about $\frac{3}{4}$ cubic foot per minute at a pressure of 50 lb. per square inch. The actual air pressure required varies according to the viscosity of the paint or varnish and the size of the brush in use. Typical air pressures are 5–10 lb. per square inch for oil-bound distempers, while for the heavy and viscous gloss paints and varnishes as much as 40–45 lb. per square inch is required.

The hand piece is easily cleaned by air at low pressure, and the brush can be readily detached from the hand piece and washed in the usual way.

# CHAPTER XV

## CELLULOSE AND CELLULOSE FINISHING MATERIALS

IT will at once be obvious from a study of the chapters on french polishing and the allied processes that much time and labour are needed to produce a finish of the high standard commonly associated with this type of finish. It is therefore not surprising to find that in order to meet modern requirements research has been directed during the past few years to the production of materials needing less laborious methods of finishing that will give effective results of reasonable durability more readily and so reduce the cost of production. The principal outcome of these researches has been the production of cellulose solutions, which can be conveniently and effectively applied by means of the spray gun. The two outstanding features of cellulose solutions as applied to wood finishing are (*a*) the rapidity with which they dry off, and (*b*) the comparative ease of application. Compared with french polishing, which is highly skilled, particularly in the spiriting-out processes, cellulose finishing is but semi-skilled. The use of the spray gun entirely eliminates the spiriting-out process, although better-class cellulose finishes often combine a certain amount of rubber work in the preliminary stages of the finishing process. The durability of french polish is, however, undeniable as compared with cellulose, since any solution applied as a film which rapidly dries out at normal workshop temperatures cannot be so durable as one produced by the slower-drying materials in which the percentage of solid content is high. Cellulose wood lacquer is expensive, and to produce films of considerable thickness numerous applications would be necessary, since generally the proportion of solid material is low, and hence the cost of production becomes excessive. The film applied by the spray gun is very thin, the solid material in the solution as already stated being small. The latter is, however, sometimes increased by adding to the cellulose such materials as collodion cotton of a low viscosity together with specially prepared solutions of various gums and resinous substances.

**Cellulose.** It is impossible here to go very far into the chemistry of cellulose as such, for little is as yet known of its constitution beyond what has been observed from numerous experiments added to a very limited number of actual facts. Cellulose is similar in many respects to starch, and is grouped as a carbohydrate ($C_6H_{10}O_5$). The preliminary process in the production of lacquers consists of nitrating cotton to produce what is commonly known as collodion cotton, pyroxylin, or nitro-cotton. Cotton linters (the short fibres of the cotton plant) are generally regarded as the best raw materials with which to work, although tissue paper and types of wood pulp are not uncommonly used in the production of collodion cotton. The raw material is first boiled in a caustic soda solution to remove any non-cellulose substances which may be present, including natural oils. The resultant material is then dried in a hot air stream, when it is ready for the nitrating process. This consists of immersing the prepared cotton in a mixture of nitric and sulphuric acids for a period depending upon the class of nitro-cotton required. The next process is one of purification, which is continued until tests indicate a product of the requisite stability for the ultimate production of the lacquer. Purification consists of two simple processes. The material is first of all washed in cold water to remove the bulk of the acid, and secondly it is boiled in a weak alkaline solution to neutralize any acid remaining after the preliminary washing. The removal of the latter is important, particularly if the lacquer is required for use on metals such as motor-car and coach bodies, in which case the proportion of acid remaining should not exceed about

0·1 per cent. At this stage the nitrated material closely resembles cotton wool, which, when dissolved in particular solvents, produces a clear liquid similar to thin varnish. A little of the latter spread over a plate or piece of glass dries quickly, leaving a very hard and durable film. As such, however, the solution is unsuitable for practical purposes, being too brittle, combined with the fact that it contracts too much while drying. Certain corrective substances are therefore added to rectify these undesirable qualities.

**Solvents.** In respect to cellulose, any liquid which dissolves collodian cotton constitutes a solvent, and many liquids do this in a greater or lesser degree. The most efficient solvent is one which will dissolve the greatest amount of collodion cotton, and produce thereby a solution which is sufficiently fluid for the purpose for which it is intended. In actual practice, however, it is not economical to use pure solvents. Certain liquids called diluents are not by themselves effective solvents of collodion cotton, but when mixed in the correct proportions with the true solvent become effective. Since the solvents are expensive, it would be a costly business to use quantities of these liquids in order to obtain the correct viscosity of lacquer for spraying, and since the solvent finally evaporates from the lacquer film it is a lost ingredient. Hence, to reduce the cost of materials, suitable diluents are added to make the lacquer of the required viscosity, the diluents being cheaper. The rate of evaporation of both solvent and diluent is important, since there must always be a sufficient quantity present of the pure solvent to maintain the collodion cotton in proper solution, otherwise the resultant film of lacquer will not be transparent. The common defect known as blooming is due to incorrect proportions of diluent and solvent. Thus, if the proportions have been fixed so that a comparatively large amount of diluent has not evaporated by the time the solvent has gone, or almost so, the collodion cotton is put out of solution and deposits itself as a white film over the lacquer. Factors affecting rate of evaporation will include temperature of workshop or the general climatic conditions in which the spraying has to be carried out.

It is impossible to give an exhaustive list of solvents and their particular features in these pages, but the characteristics of a few typical ones will be described.[1]

ACETONE. This is a distillate from some of the hardwoods such as beech, birch, and oak, and is one of the most effective solvents of nitro-cellulose. It is a colourless fluid with a pungent odour and a low boiling-point, the latter being 131°–140° F., and a flash-point of about 35° F., facts which rather restrict its use. Defects in cellulose finishes known as blushing have been traced to an excess of this solvent in the lacquer.

AMYL ACETATE. This solvent is known to be a preventive of blushing, and in view of this desirable property and its fairly high boiling-point of 212°–293° F., it is a most useful solvent. Its flash-point is 73°–100° F. Owing to market difficulties it has been largely superseded by pentacetate.

CYCLOHEXANYL ACETATE. The use of this solvent tends to make the lacquer much less inflammable, since it has a high flash-point of 149°–156° F. Its boiling-point is between 338° F. and 356° F., and it is a good solvent.

DIACETONE ALCOHOL. Being one of the slower-drying solvents, this liquid is often used for brushing lacquers. It possesses only a slight odour, has a flash-point of 43°–95° F. and a boiling-point of 320° F. to 331° F.

ETHYL ACETONE. This solvent is unsuitable for lacquers intended for metal covering, since it produces discoloration of the metal surfaces. It is a good solvent of collodion cotton, however, but has the low flash-point of 50° F. Its boiling-point is 164° F. to 174° F., and it has a light and not unpleasant odour.

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[1] The boiling-points and flash-points vary according to the degree of purity of the material.

ETHYLENE GLYCOL MONO-ETHYL ETHER. Owing to its being almost free from odour, this solvent is often used for lacquers for spraying on interior work. It is also used for brushing lacquers, being slow-drying, and it is also slow in its action as a solvent. Hence it is convenient for use in lacquers used for lining, since it is less likely to dissolve adjacent lacquer work during the lining or cutting-in processes. It has a boiling-point of 262°–278° F. and a flash-point of 104° F.

FURFURAL. This solvent is not used in high-quality lacquer manufacture, since it tends to change the lacquer film to a yellowish colour. It is manufactured from vegetable matter such as corn ears, oat husks, and other similar waste materials. It has a strong, penetrating odour, a boiling-point of 320°–329° F., and a flash-point of over 200° F.

SEXTONE. This useful solvent is used for both spraying and brushing lacquers. It imparts good adhesive properties to the lacquer with which it is incorporated, as well as good clear lustre. Sextone will also dissolve resinous substances such as bakelite. It is a colourless liquid, non-poisonous, and non-inflammable, with a pungent odour. It has a boiling temperature of 302°–329° F. and a flash-point of 117°–148° F.

**Diluents.** The purpose of the diluent in cellulose lacquer has been explained in the preliminary remarks on solvents. The fact that a diluent is added for the purpose stated does not mean that the quality of the lacquer is in any way impaired, provided that the solvent and diluent are in the correct proportions. Diluents consist of extracts from coal-tar and petroleum products. They are highly inflammable, and therefore make the liquid cellulose lacquer inflammable. The conditions under which spraying is carried out therefore require careful study, as in the form of spray the lacquer may be even more dangerous than in bulk liquid. Other ingredients of cellulose lacquer may also seriously affect the health of users and operators if the work is not carried out under proper conditions. The conditions under which cellulose lacquering and spraying may be performed as well as the storage of the liquids are governed by Home Office regulations, which should be consulted by prospective users of cellulose lacquers.

**Plasticizers.** The brittleness of the solution is modified by the use of some plasticizer, which imparts flexibility to the lacquer without destroying the hardness, which is a valuable property of the finished product. The plasticizer also increases adhesion, and the selection of a plasticizer depends largely upon the quality required in the finished product, and the purpose for which it is intended.

The object of the plasticizer is to give flexibility to the lacquer film by reducing its brittleness. Hence it is necessary to use substances for plasticizing which do not readily evaporate under normal conditions and leave the lacquer film hard and brittle, as it would be if no plasticizer were used. Numerous substances are known to fulfil these conditions in a greater or lesser degree, but nevertheless chemical research is still going on to discover more effective and permanent plasticizing materials.

Plasticizers are commonly classified according to their boiling-points, a high-boiling-point substance being regarded as a slow evaporator and a low-boiling-point substance as a rapid evaporator. The boiling temperature is, however, not necessarily a true guide as to the rate of evaporation from the lacquer film of the substances used as plasticizers, since some high-boiling-point substances also evaporate from the lacquer at a comparatively high rate. The selection of a plasticizer for nitro-cellulose lacquer depends to a considerable extent upon the purpose for which the lacquer is to be used and the conditions which it is required to endure, but almost all the high-boiling-point esters or ketones are plasticizers.

DI-AMYL PHTHALATE. This substance is one of the most extensively used of the plasticizers. It has a boiling temperature of 636°–648° F., and imparts elasticity and strength to the lacquer film combined with good weather-resisting qualities. The proportions of this substance used in lacquer solutions vary from 10 to 100 per cent by weight of nitro-cotton, and besides being a plasticizer it acts as a solvent of nitro-cellulose, resin, and other gums.

TRIPHENYL PHOSPHATE. This is a crystalline solid of whitish appearance having a boiling-point of about 770° F. As a plasticizer it has largely taken the place of camphor, a substance which has been extensively used as a plasticizer in both cellulose and lacquer manufacture. Triphenyl phosphate is soluble in benzine, amyl acetate, acetone, and other liquids, but lacquers in which this substance is incorporated lack the strength of those in which amyl phthalate is used as a plasticizer.

DI-BUTYL PHTHALATE. This is one of the most permanent plasticizers and is largely used in lacquers for steel coaches and motor-car bodies. Its boiling-point is about 617° F. and flash-point 328° F.

DI-AMYL TARTRATE. For lacquers which have to withstand varying weather conditions, this substance is particularly useful, giving a hard, durable surface. It has a boiling-point of 752° F.

DI-METHYLCYCLOHEXANYL OXALATE. One of the most important properties of this plasticizer is that it is non-inflammable, and hence when added to lacquers considerably reduces their inflammability. The substance dissolves nitro-cellulose and various resins, is colourless and odourless, and gives to lacquer power of adhesion, gloss, and marked flexibility. It is a liquid of rather high viscosity and having a boiling-point of 374°–392° F., and is marketed as Barkite.

BUTYL STEARATE. Generally, lacquers which are not to be polished by abrasion require a somewhat different plasticizer from those requiring a considerable amount of rubbing to produce a finish. Butyl stearate is useful for lacquers of the former type, but unfortunately it does not impart to the lacquer a high degree of flexibility. It has a boiling-point of 671°–694° F., and is a wax-like solid.

Di-Cychlohexanyl Oxalate. This substance provides a very good plasticizer of a durable character, and has the comparatively low boiling-point of 428° F. It is useful as a plasticizer for lacquers to be used on metal, as it does not attack the latter in any way. Di-Cychlohexanyl oxalate is a white crystalline solid, almost odourless, and neutral in effect.

Tricresyl Phosphate. Many high-quality lacquers contain this substance, since it possesses a number of valuable properties, one of the most important being that it reduces the inflammability of lacquers with which it is incorporated. Besides being a plasticizer it is also a solvent for collodion cotton. It is used in large quantities for lacquers, which can be finished by polishing with abrasives. Its boiling-point is 806°–824° F. and the flash-point 419° F.

Camphor. This substance is used in celluloid manufacture in large quantities. It can hardly be regarded as a good plasticizer, since it tends to break up when exposed, leaving the lacquer brittle, and it is also comparatively expensive. Scrap celluloid is, however, used for the purpose of plasticizing lacquers of cheap grade, the camphor in the celluloid acting as the plasticizer.

Castor Oil. The use of castor oil as a plasticizer is limited to lacquers which are not required to dry out quickly, as by its very nature castor oil is slow-drying. Any lacquer which is not required to dry out very hard, such as those used in leather work, often contains large proportions of castor oil, while it is used to a considerable extent in the cheaper grades of lacquer. In the case of coloured lacquers for coach and other work, the pigments are very often ground in this oil.

**Gums and Resins.** In order to provide cellulose lacquer with adequate adhesive power, it is customary to add as an ingredient some kind of gum or resin. The incorporation of certain gums and resins gives to the lacquer film when dry the glossy appearance which is essential in many classes of work. Without the addition of gum or resin a dull surface would result, since pure cellulose when dry is almost "flat." The amount of gum required in lacquer depends, therefore, upon the standard of gloss required on the finished surface, while lacquers for use on wood generally require larger proportions of gum than those for metal. This, of course, is due to the open-grained character of many woods, which makes them absorbent.

Synthetic gums are now commonly used in cellulose manufacture, although many of the natural gums and resins used in spirit and oil varnish are suitable. The former can, however, be produced of standard chemical form and colour, a feature which the natural gums rarely possess. Thus by using synthetic gums and resins an exact standard of quality of cellulose manufactured can be maintained. Such natural gums as copal, daman, and elemi gums were used, but for the reason mentioned are now being displaced by the synthetic materials available.

**Colouring Materials.** Although we are not concerned to any great extent in this book with opaque finishes, this section would be rather incomplete without some reference to coloured lacquers with which a great deal of wood as well as metalwork is now finished. Motor-car, coach, and vehicle bodies generally all come within the scope of this type of finish.

The amount of pigment which may be incorporated in lacquer is somewhat restricted, on account of the fact that large quantities of pigment tend to produce brittleness in the lacquer film and therefore cause chipping to occur. This defect arises on account of the small amount of collodion cotton remaining after the evaporation of the solvent, thus leaving insufficient to bind large quantities of pigment. As a result of this, cellulose lacquers are not so dense as the common oil enamels, and a larger number of coats or films is required to produce the same density of surface. The spray gun, however, enables very thin films to be applied, and the same difficulties of putting on a number of coats do not arise as when a number of coats of brushing oil enamels is required. The introduction of pigments to lacquer produces generally a liability to a defect known as "bleeding,"[1] while some pigments are not fast to daylight. These defects need careful consideration when planning colour schemes for finishes.

BLACK. The colouring material used to obtain a black finish depends upon the exact type of finish required. One of the commonest and most effective materials is the common carbon black, which imparts opacity and density to the lacquer. Other less dense black materials are improved by adding a dye called *nigrosine*, which gives a very glossy effect to black lacquers with which it is incorporated. The use of Gilsonite to produce glossy black finishes has a bitumen ingredient which is liable to cause bleeding.

BLUES. There is a variety of blue finishes, the most common of which are the bronze, Chinese, Prussian, and ultramarine shades, all of which are not dense and are spoiled by colours which bleed. The latter must be sprayed on after the blue has set.

REDS. As in the case of the blues, there is a variety of reds, and red shades such as Indian, Turkey, and Venetian. These are oxides, and on ferrous metals act as rust preventives when used as priming. They are dense and do not bleed, and are often used under a clear finishing coat of lacquer. As they do not bleed, they are useful for tinting purposes.

SCARLET LAKE. A red, partially transparent dye known as toludine red is good for tinting purposes, although it is rather expensive. Lacquers containing lake pigment often do not keep in working condition for any length of time: they tend to become jellified after a short while. For finishing in toludine red, an undercoat is generally needed to give density of colour.

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[1] The gradual penetration of one colour into another.

YELLOWS. Cadmium yellow produced from the element cadmium is an excellent yellow, but the prohibitive price restricts its use to the more expensive lacquers. Chrome yellow, which is cheaper, is more largely used for a range of yellow shades, while ochre is one of the most extensively used colourings for all the biscuit and yellow shades. Ochre is a natural product, but is also manufactured, the latter being more dense than the former.

WHITE. For white lacquers, zinc oxide and titanium oxide are commonly used. Lithapone is also largely used for white lacquers.

# CHAPTER XVI

## PLANT AND EQUIPMENT FOR CELLULOSE SPRAYING

In all workshops where cellulose spraying is to be carried out special precautions are necessary in the design of the equipment and in the lay-out of the workshops and stores. A number of companies specialize in this work and are able, therefore, to give expert advice in regard to all important matters concerning any particular problem arising in the planning of a factory and its equipment. It must be realized at the outset that cellulose solutions are mainly highly inflammable, and in the atomized condition are liable to cause explosions of a serious nature. The vapours arising from cellulose solutions are also a serious danger to the health of operatives, and precautions are therefore necessary to ensure adequate ventilation of workshops and factories in which such work is contemplated. In respect to these matters, the Home Office regulations (forms 826 and 971) must be consulted. General regulations concerning the use of cellulose materials in factories are printed in placard form for hanging in the appropriate places.

**The Spray Gun or Pistol.** This instrument is a form of atomizer and is used for applying cellulose solutions, paint, and similar materials to the work in an economical manner. It is therefore the principal piece of equipment in the shop and is operated by means of compressed air. There are two common systems in use by which the spray is produced from the nozzle of the gun. In one system, the finishing solution is placed in a container which can be connected to a compressed-air supply so that the solution is subjected to high air pressure, whence it is forced along the pipe-line to the gun. This system is shown in some detail in Fig. 15 in Chapter XIV. The spraying gun is substituted for the brush in the equipment shown in the diagram. In the other system, the solution is fed to the nozzle either by gravity or by suction. in the latter case compressed air is made to eject the fluid from its container. In the gravity type of gun the cellulose or other finishing material is held in a container fitted on the upper part of the gun above the handle, while in the suction type the container is fitted on the underside of the gun as shown in Fig. 16. For small work and work in which there is a good deal of small detail the nozzle of the gun should produce a spray of conical form, while for covering broad, flat surfaces a fan spray is desirable. Thus in some types of gun it is necessary actually to change the nozzle pieces in order to change over from one kind of spray to another. In the more recent designs, however, the change from conical to fan spray is effected merely by trigger action, and the use of other nozzles is thus eliminated. A typical gun of this type is shown in Fig. 17. By pulling the trigger *T*, the main air valve *V* is opened by an amount depending upon the extent of the trigger movement. Air which is thus released flows through a number of small orifices in the guide *G*, and a constant pressure ultimately obtains in the air channels as far up as, and surrounding, the principal orifice round the nozzle *O*. The air flowing through the orifice thus creates a conical spray. An auxiliary air valve *A* is operated by the link locking nut *L*. This valve is only moved off its seating when the nut *L* comes into contact with the preselector nut *P* fitted to the end of the auxiliary valve spindle *S*. Air which is released by the auxiliary valve ultimately passes to a pair of jets *J J*, which flatten out the cone spray to the form of a fan, the size of which is governed by another valve shown in detail in Fig. 18. The preselector nut *P* can be adjusted so that the preliminary movement of the trigger opens the auxiliary valve *A*, or alternatively the nut

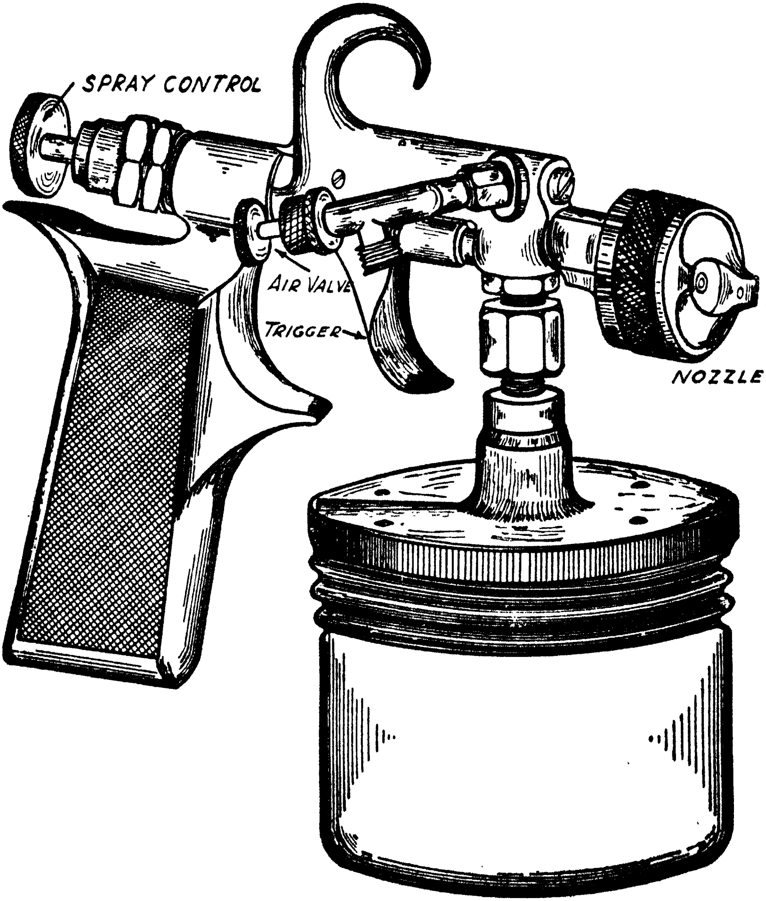
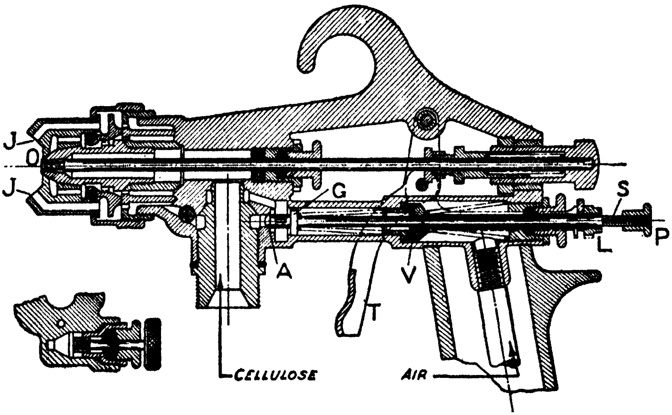


Fig. 16. Spray Gun
*(De Vilbiss)*

*P* can be adjusted so that when the trigger is pulled out to its limit the valve *A* remains closed.

It will be readily understood that a gun giving but one type of spray is of little use for comprehensive production work, since the design of the articles to be finished and the type of material to be used for finishing govern the design of the gun to a considerable extent. A glance at a manufacturer's catalogue will at once reveal the many types of guns manufactured to enable all classes and conditions of work to be undertaken.



FIGS. 17 AND 18. AERASPRAY DOUBLE-ACTING SPRAY GUN
(*Aeraspray Manufacturing Co. Ltd.*)

**Special Guns.** For dealing with large work, such as railway coaches, wagons, locomotives, ships, and the like, special extension spray guns are made, whereby the amount of scaffolding and ladder work is reduced to a minimum. The gun is of a swivelling type, can be rotated through an angle of 360°, and is mounted on two long lengths of rigid piping with the trigger control at the lower end. These pipes convey the air and finishing material to the gun. For dealing with surfaces which are inaccessible, such as in between shelving, tubes, etc., angular extension guns are made. With these, the spray can be directed at any required angle by attaching a suitable cap selected from a series of interchangeable air caps. For dealing with the interior surfaces of pipes and irregularly shaped objects a circular spray gun is made. This type of gun gives a completely circular spray and will coat interior cylindrical surfaces from 2 in. to 30 in. diameter or larger, depending upon the type of finish required.

**Pressure-feed Tank Systems compared with Gravity or Suction Systems.** What are the relative merits of these three systems ? This is a question to be anticipated and is a very important one, although to many the answer may be obvious. It will be apparent at once that when large surfaces have to be covered or when many articles similar in character have to be finished in the same way it would at least be inconvenient and involve waste of time to use a gun with a small container requiring recharging at frequent intervals. Thus for large-scale production work and in all cases where a large number of articles require the same finish the pressure-feed tank system is strongly recommended. The advantages of this system can be summed up briefly thus—

(*a*) A large amount of work can be accomplished with a minimum number of fillings of the cellulose container. With the relatively small container fitted to gravity-feed and suction-feed guns, frequent fillings and consequent loss of time are inevitable.

(*b*) The spray gun can be inclined at almost any angle. With the gun carrying its own container, the action is somewhat restricted.

(*c*) Constant and abundant supply of solution is more readily obtained with the pressure-feed tank system and greater uniformity of results is thus secured.

(*d*) A lower air pressure is required for speedy operation than is the case with the combined units.

(*e*) Arising from (*d*) it follows that the loss of material in the form of mist or spray dust is reduced to a minimum, and irritating fumes are likewise reduced to a minimum.

The containers for holding the spraying material are made in a range of sizes from 2 gallons to about 50 gallons capacity, while the containers fitted to gravity-feed and suction-feed guns are generally about ¼ pint to 1 quart capacity.

In regard to the gravity and suction system it is largely a matter of individual taste as to which system should be used. For certain classes of work, however, the gun fitted with its own container is a very important tool. For example, when small quantities of different-coloured materials have to be applied, and also for dealing with articles in small numbers, this type of gun is most useful. Also for repair work of all kinds these guns are favoured. The gravity-feed system is also extended to the use of large containers separate from the guns, the tanks being held up to the required height by lifting tackle. This type of gravity feed, therefore, resembles to some extent the pressure-feed tank system.

**Weights of Spray Guns and Air-pressure Requirements.** Spray guns are commonly built up from die castings, but where acids have to be handled special materials are employed. It is difficult to give accurate figures of a general character relating to either the weight of guns or the air requirements, since the designs vary so much, and the requirements for dealing with one finishing material vary greatly from those required by another. Some examples may, however, be of interest, and will at least give some idea as to the order of these figures. A gun for hard usage, such as appertains to most repair work, and fitted with a container weighs about 13 oz., depending, of course, on the size of the container. The air requirements of such a gun would be about 4–5 cu. ft. per minute at 40 lb. per square inch pressure. Others, for small and medium-size work, require about 2 cu. ft. per minute at 20–50 lb. per square inch pressure. From the point of view of efficient operation the weight of the gun is important. It will be obvious that the heavy gun will be more tiring to the operator than the lighter one, the ideal instrument being one which combines sturdiness with minimum weight.

**Air Compressors.** To supply the spray guns with the necessary air at the requisite pressure some type of air compressor is needed. It is essential that such compressors should be capable of supplying an adequate volume of air at the correct pressure to suit the number of guns to be operated. The efficiency of atomization will depend on these two factors, which are therefore of paramount importance. Defects in finishing such as "orange peeling" are often traceable to failure of the compressor in respect to these two conditions. The capacity of the compressor required will depend upon the number of guns to be operated, and it should be noted that a gun working with a fan spray requires about 100 per cent more air than one working with a conical spray. The required capacity of the compressor will govern the size of the cylinders, i.e. the bore and stroke dimensions, and the power necessary to drive it. Most of the air compressors used for small plant operation are air cooled, and in these cases the question of water supply does not arise. Large compressors having water-cooled cylinders require an adequate supply of water and a cooling tank. Air compressors may be driven directly by electric motor or by a belt from an electric motor or other prime mover. The Table appended gives some figures relating to capacities and the power required to drive air compressors suitable for spray gun operation. Where belt drives are used, the horse-power given in Table I must be increased by about 10 per cent to cover the belt losses.

To arrive at the cost of electric current for operating electric motors a calculation is necessary. One horse-power is equivalent to 746 watts, the number of watts taken by the motor

## TABLE I. TYPICAL AIR COMPRESSOR DATA

| No. of Cylinders | Cooling System | Bore | Stroke | R.P.M. | Displacement | Free Air Delivered | Horse-power required at Compressor Shaft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 20 | 40 | 60 | 80 | 100 |
| | | in. | in. | | ft.$^3$/min. | ft.$^3$/min. at 60 lb./in.$^2$ | lb./in.$^2$ | lb./in.$^2$ | lb./in.$^2$ | lb./in.$^2$ | lb./in.$^2$ |
| 1 | Air | 2 | 2¼ | 700 | 2·86 | 2·23 | 0·21 | 0·34 | 0·44 | 0·52 | 0·59 |
| 2 | Air | 2 | 2 | 650 | 4·72 | 3·68 | 0·34 | 0·56 | 0·72 | 0·86 | 0·98 |
| | | | | 900 | 6·55 | 5·10 | ½ | ⅞ | 1 | 1¼ | 1½ |
| 1 | Air | 3 | 3¼ | 600 | 7·97 | 6·21 | ⅝ | 1 | 1¼ | 1½ | 1¾ |
| | | | | 700 | 9·30 | 7·25 | ¾ | 1⅛ | 1½ | 1¾ | 2 |
| 2 | Air | 2½ | 2⅝ | 600 | 8·95 | 7·00 | ¾ | 1⅛ | 1⅜ | 1¾ | 2 |
| | | | | 800 | 11·93 | 9·30 | 1 | 1½ | 2 | 2¼ | 2½ |
| 2 | Air | 2⅝ | 3½ | 600 | 13·20 | 10·30 | 1 | 1⅝ | 2 | 2½ | 2¾ |
| | | | | 800 | 17·54 | 13·68 | 1¼ | 2¼ | 2¾ | 3¼ | 4 |
| 2 | Air | 3 | 4¼ | 600 | 20·86 | 16·28 | 1½ | 2½ | 3¼ | 4 | 4½ |
| | | | | 700 | 24·34 | 19·00 | 1¾ | 3 | 3¾ | 4½ | 5¼ |
| 1 | Water | 6 | 5 | 400 | 32·70 | 25·50 | 2½ | 4 | 5 | 6 | 7 |
| 1 | Water | 6 | 7 | 420 | 48·00 | 42·00 | 5 | 6 | 7 | 7¾ | 9 |
| 2 | Water | 6 | 6 | 450 | 61·30 | 53·6 | 5½ | 7½ | 8 | 9 | 11 |
| 2 | Water | 6 | 7 | 420 | 96·00 | 84·00 | 11 | 12 | 13 | 14½ | 16 |
| 2 | Water | 7 | 8 | 420 | 149·60 | 134·50 | 14½ | 20½ | 22 | 24 | 26 |

being equal to the product of the voltage at the motor terminals and the number of amperes passing through the motor. One thousand watts is called a kilowatt, and a kilowatt-hour is equal to one Board of Trade unit of electricity, on which the cost is based.

*Example.* Electric current is supplied at a contract rate of ¼d. per unit. What is the cost per hour to run a 1½ horse-power motor, and what current does it take on a 230-volt main supply ? The efficiency of small motors is about 75 per cent. Larger ones may have efficiencies as high as 90 per cent.

$$\begin{aligned} 1 \text{ horse-power} &= 746 \text{ watts} \\ \therefore 1\tfrac{1}{2} \text{ horse-power} &= 1{\cdot}5 \times 746 \\ &= 1{,}119 \text{ watts} \\ \therefore \text{Input} &= 1{\cdot}119/0{\cdot}75 \text{ kilowatts} \\ &= 1{\cdot}49 \text{ kilowatts} \\ 1 \text{ B. of T. unit} &= 1 \text{ kilowatt for an hour} \\ \therefore \text{units converted} &= 1{\cdot}49 \times 1 \\ &= 1{\cdot}49 \text{ units per hour} \end{aligned}$$

$$\begin{aligned} \text{Cost per hour} &= 1{\cdot}49/4 = 0{\cdot}38\text{d. (approx.)} \\ \text{Current to motor} &= 1{,}490/230 = 6{\cdot}48 \text{ amp.} \end{aligned}$$

**Air Receivers.** To obtain first-class results with cellulose finishes it is essential to incorporate an air receiver in the spraying equipment. This acts as a storage reservoir from which the air for operating the guns is taken. Reliable results cannot be readily obtained by connecting the spray guns direct to the air compressor delivery pipe, since the pressure fluctuates too much and the air supplied direct is generally much too dirty for refined work. Air receivers are most conveniently of the vertical cylindrical type, and should be made to the specifications for pressure vessels laid down by the insurance companies. The plates of which air receivers are constructed are generally galvanized inside and outside, and they should be fitted with a safety valve, preferably of the spring-loaded type (for portable compressors this is essential), a pressure gauge of reliable make, and a drain cock inserted as near to the base as possible. The air delivery pipe to the guns should be led off near to the top of the receiver, and the inlet from the compressor well away from it and lower down.

The air receiver has several important functions. First, it enables the air supply to the guns to be maintained at almost constant pressure. Secondly, air which is being compressed to high pressure rises in temperature as the compression proceeds, and a high temperature is, of course, unsuitable for use with cellulose solutions. By the introduction of an air receiver the air stored in it cools off to more or less normal temperature. Third, by leading off the air supply to the guns at a high point comparatively clean air can be obtained at the guns, since water and oil which are certain to come over from the compressor will settle to the bottom of the receiver in due course. The amount of water present in the air supply is, of course, dependent upon the humidity of the atmosphere —hence the need for the provision of a drain cock near the base of the receiver. For spray painting an air receiver is not generally required.

**Air Transformers and Regulators.** As a further safeguard in preventing dirt, oil, and water reaching the spray guns, it is usual to fit an air transformer and regulator in the pipe-line between the receiver and the guns. The transformer contains a number of baffle plates which arrest solid matter, oil, and water, thus ensuring a clean supply of air to the spraying guns. The oil and water collected are drained off at intervals by means of a tap fitted at the lower end of the transformer. Two pressure gauges are also fitted, one on the main air supply to the transformer, the other on the air supply from the transformer to the guns. The air pressure required, which will depend upon the characteristics of the material to be sprayed, is regulated by a valve on the air receiver side. The transformer should be placed as near to the spray guns as possible. As an additional safeguard, particularly where the pipe-lines are of necessity rather lengthy, special filters are fitted adjacent to the guns. Extensive precautions are obviously necessary to ensure clean, dry, and cool air, and defects in cellulosed work can often be traced to defective or unsuitable equipment.

**Air and Fluid Hose Pipes.** The essential qualities of hose for spraying work is that it must combine good wearing properties with strength to resist internal pressure, lightness, and flexibility. Those pipes which are to carry the finishing solutions must also be capable of resisting the action of the solvents and must have no effect upon the colour of the solutions. The fixed pipe-lines from the compressors to the receivers and from the receivers to the transformers should be of galvanized steel and not generally smaller than ½ in. diameter bore. The pipes should be arranged as far as possible so that throughout their run considerable variations in temperature are avoided. Drainage points should be provided in long pipe-lines. Metal-lined hose pipe, although still used for special purposes, has now been superseded by specially constructed composition flexible piping built on the two-braid principle. The metal-lined pipes are used for conducting solutions which would attack the composition ones. All piping to be used for spraying work must of necessity be subjected to rigorous tests, and it should be designed to combine all the essential qualities for the work for which it is intended.

Air pipes of $\frac{5}{16}$ in. bore are recommended for production spray guns, and $\frac{7}{16}$ in. bore pipes should be used for connecting the pressure feed tank to the transformer or the main air supply. For light-duty spray guns and for production spray guns where the length of pipe does not exceed 12 ft., pipes of

¼ in. bore are suitable. The relative positions of the various pieces of equipment described in the foregoing paragraphs and a lay-out of the equipment are shown in Fig. 19.

**Air Dusters.** These vary somewhat in design, but commonly consist of a conical nozzle over which a brush is sometimes fitted. In some cases no brush is provided, the duster being merely a form of blower. Air dusters are used for removing sand-paper dust, etc., from the work before spraying. They are particularly useful for removing dust from corners, mouldings, and other intricate parts. At an air pressure of 50 lb. per square inch an efficient duster requires about 1½–1¾ cu. ft. of air per minute.

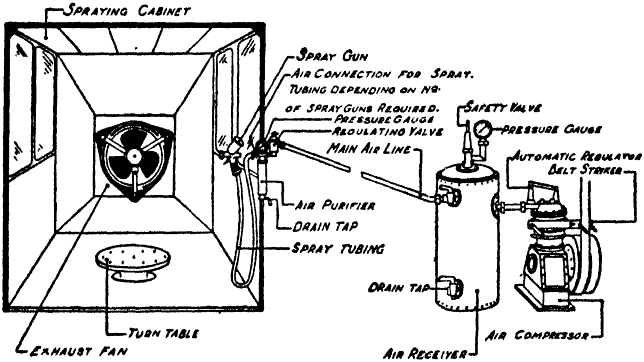


FIG. 19. ARRANGEMENT OF CELLULOSE SPRAYING PLANT

**Polishing Machines.** For the treatment of lacquers which require finishing to a high gloss by rubbing, buffing and polishing machines are manufactured. Rubbing machines for dealing with large flat surfaces working at from 1600–1800 strokes per minute are obtainable as well as machines with rotating buffs.

**Electric Heaters.** Some finishing solutions require heating before use, which is safely and conveniently performed by specially designed electric heaters which raise the temperature of both the air and solution. These heaters are fitted near to the transformer, and in some designs are arranged to clip on to it.

**Portable Spraying Plant.** These are largely used for spray painting and consist of all the essential apparatus such as the air compressor and its motor (either electric or petrol), the air receiver, and transformer, mounted on a trolley which can be easily moved by hand to any desired position. The conditions under which such a plant can be used for cellulosing need careful consideration.

**Automatic Spraying Machines.** For certain classes of mass-production work, mainly in the form of small and medium-sized parts, spraying can be carried out by automatic machines. The description of these machines is inappropriate in these pages, and details if required can be obtained from any of the manufacturers.

**Spraying-booths and Finishing Rooms.** As already pointed out, the vapours arising from most of the cellulose finishing solutions are not only highly inflammable but injurious to the health of operatives. In order to remove these dangers, special means have to be adopted by way of providing for all work to be finished, either in specially designed spraying-booths or in properly equipped spraying-rooms, according to the size of the work. The risk of fire is met by using specially designed equipment for lighting and ventilating, and by proper positioning of the equipment. In spraying-rooms for large work the air must be constantly changed. This is accomplished by fitting a number of exhausting fans in the walls so that the contaminated air can be discharged direct to the atmosphere. Fresh air is then led into the room through ducts fitted in selected positions so as to ensure efficient circulation and cleansing. The exhaust fans should be placed near the ground, since the fumes from some of the solutions are heavy and therefore hang in the lower atmosphere of the room.

Small cabinets, each fitted with exhausting fans, are generally arranged so that they discharge into a common duct which is led away to the outside air. Fans for spraying-rooms and booths may be driven either directly by electric motors or by belts from electric motors. If driven by the latter method, the motor can often be placed far enough away from the work so that any sparking from its commutator is not likely to cause fire, but where motors are to be direct-coupled to the fans they must be of the flameproof type. The blades of exhausting fans should also be made of non-sparking metal, and where fans are incorporated in the exhaust ducts the motor must be in an external chamber, the belt also being enclosed in a vapour-tight air-cooled metal housing.

In spraying-rooms, air should be renewed about 30–35 times an hour, and air inlet ducts should be situated opposite exhaust fans and from 7 ft. to 9 ft. above the floor level. For spraying of furniture and other large objects, short ducts to the outside air are desirable. Long ducts are not recommended, since solid matter collects in them, which adds considerably to the risk of fire. If ducts are essential, the deposits of solid matter are reduced considerably by keeping the air speeds to within 75–100 ft. per minute. Solid matter can, to a large extent, be prevented from getting into ducts by putting a filter composed of wood wool into the front end of the duct.

**Heating Arrangements for Spraying-rooms.** Heating of rooms by water pipes is the safest and best system. By this means temperatures of pipes above 212° F. are excluded. Steam and electrical heating systems should not be used.

**Lighting.** Artificial illumination of spraying-rooms is restricted to the electric lighting system in which incandescent, or mercury-vapour lamps are suitable. All wires must be contained in heavy-gauge steel screwed conduit, and switches must be completely enclosed.

**Turntables.** To facilitate production, spraying-booths should be fitted with turntables for supporting the work. These enable the work to be rotated easily to any desired position. An operator can always keep the work between himself and the exhaust fan, and can always view the work from the same standpoint and therefore with the same light. For large work of, say, half-ton weight, pneumatic turntables are made. These enable the work to be raised to any desired height, and rotation is easily effected to any desired position. Small turntables for tilting to various angles are also obtainable.

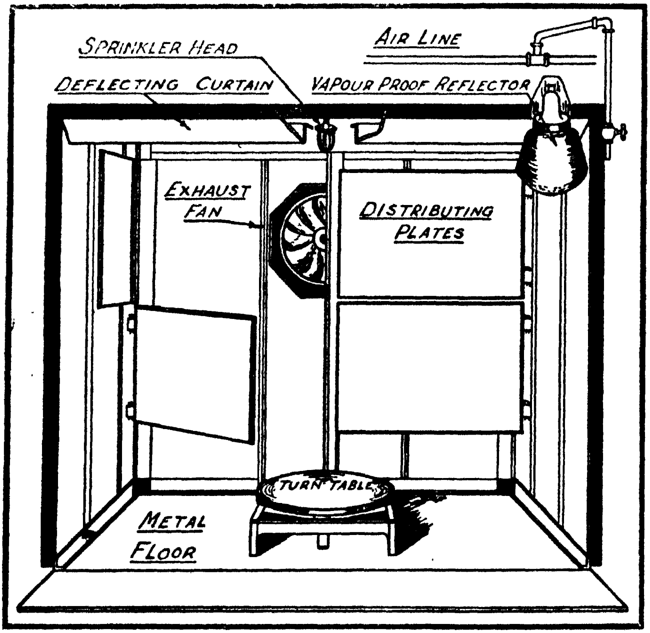


FIG. 20. SPRAYING-BOOTH WITH BAFFLE PLATES FOR FINISHING FURNITURE

Fig. 20 shows a typical type of spraying-booth and its equipment. In all proposed installation work the Home Office regulations must be complied with, and reliable firms specializing in this work should be employed to undertake it.

Tables II and III give some data relating to exhaust fans from which costs of running can be computed.

TABLE II. EXHAUST FAN DATA, WINDOW AND WALL TYPE
(ENCLOSED MOTOR, BELT DRIVEN)

| Horsepower | No. of Blades | Diameter Over Blade Tips | Diameter of Exhaust Ducts | R.P.M. | Capacity (Installed Conditions) |
|---|---|---|---|---|---|
| | | in. | in. | | ft.$^3$/min. |
| ¼ | 6 | 16 | 17½ | 1,750 | 2,400 |
| ½ | 6 | 16 | 17½ | 2,000 | 2,860 |
| 1 | 6 | 22½ | 24 | 1,750 | 6,500 |
| 2 | 5 | 22½ | 24 | 1,750 | 7,600 |

TABLE III. DIRECT-COUPLED PROPELLER EXHAUST FAN DATA

| Diam. Over Blade Tips | DIRECT CURRENT | | | ALTERNATING CURRENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 100–250 Volts, 50 Cycles, Single-phase | | | 100–500 Volts, 50 Cycles, Three-phase | | |
| | R.P.M. | Air Delivered | Power | R.P.M. | Air Delivered | Power | R.P.M. | Air Delivered | Power |
| in. | | ft.$^3$/min. | watts | | ft.$^3$/min. | watts | | ft.$^3$/min. | watts |
| 12 | 1,400 | 1,150 | 65 | 1,400 | 1,150 | 105 | 1,410 | 1,160 | 55 |
| 15 | 1,400 | 2,420 | 135 | 1,370 | 2,400 | 160 | 1,400 | 2,420 | 115 |
| 18 | 900 | 2,578 | 120 | 920 | 2,600 | 195 | 920 | 2,600 | 155 |
| 24 | 710 | 4,900 | 200 | 710 | 4,900 | 282 | 720 | 4,920 | 200 |
| 30 | 550 | 7,750 | 350 | 560 | 7,800 | 375 | 560 | 7,800 | 355 |

## CHAPTER XVII

### CELLULOSE WOOD FINISHING

**Surface Preparation.** The methods of preparing the "white" wood for cellulose finishing have already been given in detail in Chapter II, for similar conditions of the wood surfaces are required for finishing by french polishing. Only a few words of emphasis, therefore, need be added to what has already been adequately covered in that chapter. It is of the utmost importance that the wood be perfectly dry, and therefore it must be thoroughly seasoned. The common defect of peeling which occurs after the cellulosed articles have been in use for a short time can often be traced to the presence of moisture in the timber when the cellulosing was carried out. The fact is that moisture under the surface of the cellulose destroys its power of adhesion—hence the peeling off. Careful glass-papering in the direction of the grain to remove scratches and irregularities is all-important, and a little extra labour in preparation may save a lot of trouble later on in the finishing processes.

**Grain Filling.** Various grain fillers already prepared for use are now marketed. Some are suitable for application with the spray gun, although it is generally considered that in the end best results are procured when the filling has been brushed in. In order to save time in drying, cellulose fillers, i.e. those in which cellulose is added as a thinner, are used. Of the slow-drying types, which are usually applied with a brush or coarse rag, there are two kinds of filler. One consists of materials thinned to correct consistency with oil, and the other consists of materials soluble in water.

**Oil-thinned Fillers.** Such substances as barium sulphate, quartz, silica, and whitening are commonly used as the basis of oil fillers. Any one of these materials mixed with driers and oil to a paste of creamy consistency will make a filler suitable for use under a cellulose finish. To apply such a filler it may be thinned with naphtha or turpentine; the former, being more volatile, dries out more quickly than the latter.

**Water Fillers.** These consist of materials which are soluble in water such as casein and gelatine. These substances, unlike those used in the oil fillers, are not affected by the majority of solvents used in the manufacture of cellulose. The chief advantage of the use of water fillers is that lacquer films applied over them do not sink once they are dry.

Fillers in general may be applied with a coarse rag, and should be well forced into the grain by working the rag across the grain. Any excess filler should be removed before it has had time to harden, and when the work is thoroughly dry it should be glass-papered down perfectly smooth. The amount of filling required will depend on the state of the grain of the wood, the open-grained varieties needing perhaps more than one filling. It should be noted here that the filling tends to contract as it dries, some fillers more so than others, and hence the surface of the work after a coat of filler should be studied closely to ascertain whether a satisfactory result has been achieved. Each filling must thoroughly harden before another is added, and glass-papering between fillings is essential. Attention is once more directed to the important fact that before any spraying of cellulose is attempted it is essential that the work be thoroughly dry, particularly if water fillers have been used. Some hours may therefore be necessary for drying before lacquering can be commenced.

The question of whether the filling should be done before or after staining depends upon whether a grain contrasting in colour with the groundwork is required. If it is, then the staining must precede the filling. Effects which can be produced by contrasting the colour of the filling with that of the groundwork have been given in some detail in Chapter XII.

**Staining.** So comprehensive is the range of stains now marketed that few would consider it worth while to make up their own stains. It does, however, sometimes happen that only small quantities are required, which in the circumstances could perhaps be more conveniently made up for the purpose. For experimental work also it might be desirable to make up one's own stains, and a few remarks relating to the manufacture of stains for cellulose finishes will not be out of place.

The majority of the stains used under cellulose finishes are aniline dyes, of which there are four groups, viz. (1) those dyes which are soluble in alcohol; (2) those which are soluble in water; (3) those which are soluble in both alcohol and water; (4) those which are soluble in oil. The following classification, although not exhaustive, gives typical examples in each of the groups referred to above—

Group 1. Aurene, bismarck brown, chrysoidine, spirit black, spirit blue, malachite green.

Group 2. Fast brown, black, bright blue, mahogany, methyl-orange, nigrosine, red, vandyke.

Group 3. Bismarck brown, malachite green, magenta, methyl-violet, naphthal yellow.

Group 4. Oil crimson, oil brown, oil violet, oil yellow.

The water-soluble stains are acid, while those soluble in spirit are alkaline, the acid ones having great brilliance of colour. They are somewhat dangerous to use, and workers require rubber acid-proof gloves when dealing with them. The spirit dyes are not very largely used under lacquer, although they penetrate well and dry off more quickly than the water dyes.

Oil stains are unfortunately often not fast to daylight, and if used should be left to dry in darkness. As a thinner for oil stains naphtha or benzol should be used, as these fluids, being volatile, make the stain dry off quickly. Some brilliant colours are procurable in oil stains.

**Water Stains.** As already stated, these stains are the most brilliant and incidentally retain their true colour the longest, being almost permanent and unaffected by light. Furthermore, they offer no reaction to lacquer, being quite dormant under a cellulose finish. They are conveniently applied by means of a sponge in the manner detailed in Chapter IV, but can also be applied with the spray gun. It is important to remember that thin coats are better than heavy ones, and a coat of stain must be thoroughly dry before another is laid on. Each coat should be well glass-papered when thoroughly dry before the addition of another coat. Water stains, too, give more satisfactory results if applied warm, i.e. at temperatures a little above the normal.

**Sealers.** The object of a sealer is to block the pores of the wood so as to stop the succeeding coats of lacquer sinking in. Fewer coats are therefore needed to produce the required finish, and a saving in materials and labour is thus effected. Sealers consist in solutions of white shellac in denatured alcohol, and can be applied with the spray gun or otherwise. About $\frac{3}{4}$ lb. of pure white shellac dissolved in a gallon of denatured alcohol makes a good sealer. The strength may, of course, be varied to suit particular needs. The use of a sealer after filling is not universal practice, and the question of its use depends to a large extent upon cost and standard of finish required.

**Cellulose Lacquer Finishing for Woodwork.** The method of finishing off woodwork with cellulose lacquer depends largely on the question of cost. While it is possible to obtain spraying lacquers which dry off with the lustre common to french polish, it is only to the cheaper grades of work that such finishes are applied. The best lacquer finishes embody a certain amount of rubber work, either prior to the lacquering or in between the coats. It is not uncommon in good-class work for it to be bodied up by the processes of french polishing before being finally completed by one or more coats of lacquer, depending entirely upon the class of finish and the durability required. Glossy lacquers used in the cheaper grades of work are sprayed on, and no hand finishing of any sort is applied. Such finishes will not stand up to hard wear and tear, and are easily damaged by heat. Better-class work has a body on it produced either by hand or with the spray gun.

**Bodying Up.** This may be accomplished either by the hand processes detailed in Chapter V, or by spraying on lacquer possessing a good body and specially prepared for the purpose. One or more coats may be required to produce the desired standard of quality, in which case ample time must be allowed between the coats for drying, and each coat must be well glass-papered down before adding another coat of bodying-up lacquer. First coats may require from 2 to 4 hours to harden off before glass-papering in preparation for subsequent coats, which may be applied at shorter intervals of say 1–1½ hours. The question of time between coats depends largely upon the nature of the materials used. Glass-papering is important, since with either shellac or cellulose spraying, surface irregularities are bound to arise.

**Polishing.** If a brilliant finish is required, this may be procured on cellulosed work by one of two methods. The older one consists of working up the surface with rotten stone and oil, or by using one of the abrasives in oil sold specially for the purpose. The more recent treatment is similar to the spiriting out process applied to french polish. A mixture of diluents and solvents of sufficient strength just to dissolve the surface of the lacquer film is applied by means of a rubber similar to that used by a french polisher for spiriting out. The cotton-wool core, however, is covered by a piece of chamois leather instead of linen. By working the rubber as directed in the notes relating to spiriting out in Chapter V, a brilliant finish can be produced.

**The Pull-over.** This is a trade term. After a surface has been sprayed with cellulose lacquer, irregularities of the surface occur which are removed by what is called a pull-over. This consists of working the surface with a rubber, of the type referred to in the previous paragraph, which is charged with a special fluid made from methyl acetone, butyl acetate, methylated spirit, and toluol. The proportions of these in the mixture are fixed according to the viscosity of the lacquer on which it is required to work.

**Orange Peel.** This is another trade term relating to surface condition. Particularly in the earlier stages of surface preparation, as the surface dries out it often has the appearance of the outer surface of orange peel. This condition is corrected by glass-papering and adding further coats of lacquer on similar lines as directed in the previous paragraphs.

**Special Finishes.** Brilliant finishes of the type associated with pianoforte cases are achieved by spraying and rubbing. Preliminary coats of bodying-up material are sprayed on at intervals of 2–4 days. Before the final coat is put on, the body is well cut down with very fine carborundum powder (optical finest grade) or pumice powder, with water or paraffin oil as a lubricant. This eliminates spray marks and prepares the surfaces for the spraying-on of the final full coat of lacquer. Finishing off with wax polish to improve the lustre is sometimes adopted for certain classes of work, the method of application and kind of wax being the same as already given in Chapter IX.

**Satin Finishes.** Flat lacquers are obtainable which dry off as a satin finish, i.e. semi-lustrous and of a rather refined appearance. Different grades of brilliance of surface can be achieved by mixing in suitable proportions the flat and glossy lacquers. Some care is needed in mixing these, as all lacquers are not suitable for mixing one with another.

**Inlaid Work.** The finishing of this work with cellulose lacquer is often difficult on account of the fact that the materials used for sticking the various parts of intricate inlays are often destroyed as soon as they come into contact with the cellulose lacquer. The dyes, too, with which the inlays are coloured, are not always fast to the lacquer and tend to bleed out. When dealing with inlays it is best to seal them with shellac before attempting to spray. For this purpose the lacquer may be applied with a soft-hair brush.

**Coloured Enamels.** Much of the coloured woodwork now on the market is sprayed with coloured cellulose enamels. For this work a primary coat is needed, and if the wood is of a particularly open-grained variety time and materials will be saved by filling. Priming or filling coats which can be sprayed on consist of flat oil paints impervious to cellulose, and these should be of approximately the same colour as the finishing coat of cellulose enamel. If the work is filled in in the ordinary way, fillers containing alkaline matter should be avoided. Whitening and glue size, for example, should not be used, as these substances (or the alkaline portions) attack some colours and destroy them. Prussian blue, for example, is one which is spoiled by alkaline substances.

**Special Effects.** Many of the shaded effects common in modern furniture are obtained by skilful manipulation of the spray gun, and not by using more than one colour as might be suspected. By varying the thickness of the lacquer film, striking effects can be obtained.

# CHAPTER XVIII

## DEFECTS COMMON TO CELLULOSE FINISHING

SOMEWHAT broadly speaking, the defects common to cellulose finishes may be placed into three categories—

(*a*) Those due to unskilled or careless workmanship;
(*b*) those due to the use of unsuitable materials;
(*c*) those due to superficial conditions of the work before spraying on the final coats of lacquer.

In regard to (*a*), incorrect spray gun movement or the fact that the gun is not held at the correct distance from the work is apt to produce poor results and several serious defects. The correct distance to hold the gun from the work depends on the type of nozzle in use. Whatever that may be, the stream of lacquer spray leaving the nozzle is generally divergent, and hence for a given rate of flow from the gun the farther away from the surface of the work the thinner will be the lacquer film deposited. Also the farther away the gun is held the greater is the diffusion of the spray and the consequent wastage of lacquer. The correct position of the gun relative to the surface is, therefore, one which gives a thin but adequate film on the work with a minimum amount of labour, and as little wastage as possible. The viscosity of the fluid to be sprayed and temperature conditions affect this question.

## DEFECTS IN PARTICULAR

**Blooming.** The appearance on the surface of finished work of a misty hue indicates blooming, which is attributable to several causes, but most commonly to incorrect temperature and hygrometric conditions under which the work has been carried out. It is advisable to have permanently in both the spraying and drying shops a wet- and dry-bulb thermometer. In this country, and those having similar climatic conditions, the respective readings of this thermometer should be maintained between 63° and 66° F. and 56° and 58° F. Cold air currents which may come into contact with the work should be carefully avoided. Draughts may occur due to wind blowing down the exhaust ducts of the spraying-booths. These may be to a large extent prevented by the fitting of a suitable cowl over the outer ends of the exhaust ducts. Another cause of blooming is attributable to the main air supply to the gun. This should not be at too high a pressure, and the air must be dry and free from oil. Outdoor work should not be attempted when the temperature and hygrometric conditions are unsuitable. To correct blooming, the work should be sprayed with a solvent and then left to dry in the warm drying shop. Sometimes bloom will disappear if the work is placed for a few hours in a warm room at a temperature of not less than about 80° F. or more than 90° F. This method is worth trying first before the use of a solvent if convenient to do so.

**Blistering and Pin-holing.** These two conditions are similar, a pin-hole being the term used to describe the result of a small blister after bursting. The cause of these defects is due mainly to the presence in the coatings of trapped air, vapours, and possibly water as a result of improper drying conditions or inefficient air purification in the pipe-lines. When the cellulose film is put on, the air is freed by the wetting effect of the lacquer and rises to the surface. The smaller collections burst and leave a series of pin-holes, while the large ones remain as a series of unburst air bubbles. Several conditions may give rise to these defects. The coats comprising the complete finish may not adhere to one another properly, due possibly to inefficient surface preparation. The presence of water or grease is a common cause of lack of adhesion, while materials manufactured by different makers used on the same job will also account for trouble of this nature. If oil or water is suspected as being the cause of blistering, then attention should be given to the air purifier and the air pipe-line. The spraying of cold lacquer, possibly brought in direct from the stores, on to warm surfaces is another cause of blistering. To guard against trouble arising from this cause, the lacquer should be allowed to stand in a warm place for a time before using so as to give its temperature a chance to rise to that of the surfaces with which it is to come into contact. Another cause of these defects is the hurrying-up of the drying of the constituent coats; particularly will defects arise under these conditions if the coats are thick. The temperature of the drying shop should be kept as near constant as possible and in the neighbourhood of 83° to 95° F. Serious blistering cannot be corrected. The only thing to do is to clean off the defective surfaces and relacquer. Pin-holes and small local blisters can be glass-papered down and the surface given an additional coat of lacquer.

**Bridging.** This defect is the collection, locally as a rule, of excess lacquer or other material and the resultant cracking which occurs of the adjacent film on drying out, due to the unequal strains set up in the film surface. Work most prone to this trouble is that embodying in the design quirks, mouldings, and corners, for in the intricacies of these, and in the sharp corners, there is a great tendency for material to collect excessively. Corners should be well cleared of all filling and other materials, and careful gun operation is needed to avoid this defect. In dealing with the curved surfaces of the larger concave mouldings, for example, the gun should be directed up at such an angle that the curvature of the moulding tends to direct the spray out of itself. If the angle of the gun is incorrect, excess material will collect at the lowest points or edges of the sweep, and bridging will result. Any parts of a surface suffering from this defect can be cut away carefully with glass-paper and touched up with further coats of lacquer. Renovation of this sort calls for considerable skill on the part of the worker.

**Cracking.** This occurs due to unequal straining in the lacquer film, originating probably in the undercoats or filling, and due often to working one coat on top of another at too frequent intervals. Plenty of time to harden off must be allowed in between coats, otherwise this defect is probable. Work most prone to cracking is that on which oil-bound materials have been used in the undercoats and filling. The oil, if not thoroughly dried out, prevents parts of the coat drying out properly at a uniform rate—hence the unequal straining actions. Incorrect materials will also produce this defect. To correct cracks, the smaller ones may possibly be cut out; but if the defect is general, the whole surface must be cleaned off and relacquered. It always pays in the long run to allow ample time for coats to dry out, and this point cannot be over-emphasized.

# APPENDIX I

## STANDARD SPECIFICATIONS

STANDARD specifications for many of the materials used in the finishing trades have been prepared and published by the British Standards Institution. The use of materials which comply with these standards not only ensures the use of those which will produce consistently good results, but also enables stocks to be replenished and maintained at a uniform quality. Complete specifications can be purchased direct from the British Standards Institution, 28 Victoria Street, London, S.W.1, or through local booksellers. These specifications contain useful information and should be consulted. The following list of materials, although not exhaustive, contains the more important materials used for which standard specifications have been prepared, the number referring to the appropriate specification.

Barytes, 260
Driers, 331, 332
Gold-size, 311
Green oxide of chromium, 318
Indian reds, 305
Lamp-black, 287
Lead chromes, 282
Linseed oil (boiled), 259
Linseed oil (raw), 243
Linseed oil (refined), 242
Naphthas, 479
Natural sienna (raw and burnt), 312
Natural umber (raw and burnt), 313
Normal butyl alcohol, 508
Ochre, 337
Prussian blue, 283
Red lead, 217
Red oxide, 272, 295, 298, 299
Silica, 301
Tinted oil pastes, 262, 278, 393
Ultramarine blue, 314
Vandyke brown, 319
Vegetable black, 286
Venetian red, 370
Vermilion, 320
Varnish: Exterior oil, 257; exterior hard-drying, 274; flatting or rubbing oil, 258; interior oil, 256
White lead (dry), 239
Zinc oxide, 254
Zinc oxide oil paste, 273

# APPENDIX II

## MARKETED VARIETIES OF FRENCH POLISH

Pure polish
Button polish
French polish
Dark polish
Heavy dark polish
White polish
Heavy white polish
Red polish
Black polish
Crystal polish
Pale crystal polish
Brush polish
Floor polish
White transparent
Table-top polish
Dark transparent polish
Transparent button polish
No. 2 french polish
No. 2 dark polish
No. 2 white polish
No. 2 button polish
Piano polish, pale
Piano polish, dark
Weatherproof polish, pale
Weatherproof polish, dark
Glaze
Glaze white
Spray polish

# APPENDIX XII

## MARKETED VARIETIES OF SPIRIT VARNISH

Best hard varnish
No. 2 hard varnish
Naphtha varnish
Shellac varnish
Stick white varnish
Knotting
White knotting
Pure white knotting
Pure shellac knotting
Crystal varnish
Golf varnish
China varnish
Amber varnish
Black varnish
Gut varnish
China black enamel

# APPENDIX IV

## DECORATORS' VARNISHES

There are some sixty or more different varnishes on the market. Only typical ones are therefore mentioned.

White Coburg. For inside or outside use over pale tints.

Copal Oak. Good general varnish, very durable, with excellent lustre.

Oak. Durable varnish and extensively used in large work. Good-wearing.

Cathedral Oak. Interior work in churches, particularly the seats and parts which are handled a good deal.

Crystal Paper. Almost colourless and therefore suitable for paper-hangings.

White Copal Body. One of the most durable varnishes made. Used extensively in finishing railway vehicles, tram-cars, etc.

Elastic Copal Carriage. Used also for carriage work.

Engine Copal. Withstands high temperatures without cracking.

Pale Copal Yacht. Withstands sea air and sea water, and never shows white or frosty.

Boat Varnish. Very durable for general boat work.

Black Japan. Dense black, elastic, and hard-drying. Used largely for coachwork.

Best Brunswick Black. Quick-drying. Is used largely for ironwork.

Betulastic. Cheaper than Brunswick and used for similar purposes.

Best Berlin Black. A dull-drying varnish used for gas fires, grates, stoves, etc.

# APPENDIX V

## CHEMICALS USED IN STAINING AND POLISHING

POPULAR and chemical names for some of the materials used in staining and polishing are given below, together with their appropriate formulae—

| Popular Name | Chemical Name | Formula |
|---|---|---|
| Alcohol | Ethyl alcohol | $C_2H_5OH$ |
| Ammonia water | Ammonium hydroxide | $NH_4OH$ |
| *Aqua fortis* | Nitric acid | $HNO_3$ |
| Barytes | Barium sulphate | $BaSO_4$ |
| Blue vitriol | Copper sulphate | $CuSO_4.5H_2O$ |
| Caustic soda | Sodium hydroxide | $NaOH$ |
| Caustic potash | Potassium hydroxide | $KOH$ |
| Copperas | Iron sulphate | $FeSO_4.7H_2O$ |
| French chalk (Talc) | Magnesium silicate | $MgSiO_3$ |
| Green vitriol (Copperas) | Iron sulphate | $FeSO_4.7H_2O$ |
| Lithapone | Barium sulphate + zinc sulphide | $BaSO_4 + ZnS$ |
| Litharge (Massicot) | Lead oxide | $PbO$ |
| Methylated spirit | Ethyl alcohol + methyl alcohol + methyl violet dye | — |
| Oil of vitriol | Sulphuric acid | $H_2SO_4$ |
| Potash | Potassium carbonate | $K_2CO_3$ |
| Chromate of potash | Potassium chromate | $K_2CrO_4$ |
| Bichromate of potash (Chroma) | Potassium bichromate | $K_2CrO_7$ |
| Permanganate of potash | Potassium permanganate | $KMnO_4$ |
| Quicklime | Calcium oxide | $CaO$ |
| Red lead (minium) | Lead oxide | $Pb_3O_4$ |
| Silver sand (Silica) | Silicon dioxide | $SiO_2$ |
| Slaked lime | Calcium hydroxide | $Ca(OH)_2$ |

| Popular Name | Chemical Name | Formula |
|---|---|---|
| Soda ash | Sodium carbonate | $Na_2CO_3$ |
| Spirits of salts (Muriatic acid) | Hydrochloric acid | $HCl$ |
| Sugar of lead | Lead acetate | $Pb(C_2H_3O_2)_2$ |
| Titanium white | Titanium oxide | $TiO_2$ |
| Turpentine (Turps) | — | $C_{10}H_{16}$ |
| Vinegar | Acetic acid | $CH_3COOH$ |
| Washing soda | Hydrated sodium carbonate | $Na_2CO_3.10H_2O$ |
| Water | — | $H_2O$ |
| White lead | Lead carbonate | $2PbCO_3.PB(OH)_2$ |
| White vitriol | Zinc sulphate | $ZnSO_4.7H_2O$ |
| Zinc white | Zinc oxide | $ZnO$ |

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